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EUGEN VADERS, OF FRANKFORT-ON-THE-MAIN, GERMANY

COPPER-SILICON ALLOY

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This invention relates to improvements in copper-silicon alloys.

The known copper-silicon alloys have a small tenacity but are very ductile. These alloys could therefore be stretched or rolled to wires or bars, but were not adapted for casting purposes.

According to the invention copper-silicon alloys are made suitable for casting purposes by especially proportioning their silicon content and by further addition of iron and nickel. The proportions are preferably within the following limits: 1 to 4% silicon, 4 to 6% iron, 1 to 5% nickel. The alloys obtained by making these additions within the above limits have a tenacity up to 45 Kg/mm² and above. By keeping the additions of silicon, iron and nickel at or near the above given minimum limits the alloys may still be rolled, pressed, stretched or worked upon in a similar manner.

The new alloys are further improved by addition of other metals such as tin, manganese and aluminum. These additions are however smaller and principally below 1%. Especially tin tends to improve the distribution of the iron in the copper-silicon crystals. Manganese produces a further increase of the tenacity and makes the structure more fine-grained. The addition of aluminum gives the cast pieces a smooth surface.

It is naturally not essential that all the three last mentioned metals be present as additions in the alloys. By addition of only one or two of these metals the new alloys may be influenced in the described manner.

Example

The following raw materials may be used for making the new alloys:

Nickel-iron alloy containing 50% nickel, silicon-iron alloy containing 50% silicon, silicon-copper alloy containing 10% silicon, aluminum-iron alloy containing 50% aluminum, manganese-copper alloy, containing about 25% manganese. For making 100 kg. of one of the new alloys 70.7 kg. of chemically pure or electrolytic copper or the like are charged with 20 kg. of silicon-copper into a crucible furnace. When the melt has taken up the suitable temperature 6 kg. of nickel-iron and 2 kg. of silicon-iron are added. When the whole charge has become liquid small amounts for example 300 g. of aluminum-iron and 500 g. of manganese-copper are added. The melting process is preferably carried out under charcoal protection. When the crucible has been removed from the fire finally 500 g. of tin are added and the whole melt is once thoroughly stirred. The content of the crucible is then allowed to cool a little and cast at not too high a temperature of about 1100 to 1200° C.

I have further found that the same tenacity or a still greater tenacity of the new alloys is obtained, when the new alloys contain an addition of not more than 20% of zinc. In this case it is also possible to increase the amount of iron and nickel in the alloys.

An alloy containing 5% of nickel, 5% of iron, 10% of zinc, 2 or 3% of silicon and less than 1% of tin is made in the following manner: A part of the necessary copper consisting for example of waste copper with tin or zinc as impurity, is first charged with a part of the necessary iron, containing as little as possible carbon, into the crucible. This mixture is then strongly heated, in order to obtain a uniform mixture, of iron and copper. Then the remaining amount of iron is added in the form of a 50% iron-silicon together with silicon-copper and the remaining part of copper. The whole mixture is then molten under a cover of charcoal and the corresponding amounts of nickel and zinc are added for example as laminated German silver at the moment of the liquefaction of the mixture. The obtained alloy is easily worked by cutting tools.

It has further been found, that the tenacity of all the new alloys is improved by a subsequent heat treatment. By heating the new alloys first to temperatures between 750 and 950° C. for example for an hour, then quenching them with water or another liquid and finally reheating them for example up to about 1, 2 or 3 hours or longer to temperatures between 350 and 600° C. not only their tenacity but also their hardness is improved.

I claim:

1. A casting alloy consisting predominantly of copper and containing 1–4% of silicon, 1–5% of nickel, 4–6% of iron and an addition of 8–20% of zinc.

2. A casting alloy consisting predominantly of copper and containing 1–4% of silicon, 1–5% of nickel, 4–6% of iron, 8–20% of zinc and a small addition of at least one of the metals tin, manganese and aluminum.

3. A casting alloy consisting predominantly of copper and containing 1–4% of silicon, 1–5% of nickel, 4–6% of iron, 8–20% of zinc and an addition of not more than 1% of tin, not more than 1% of manganese and not more than 1% of aluminum.

4. A casting alloy consisting predominantly of copper and containing 2.5% of silicon, 5% of iron, 5% of nickel, 10% of zinc and 0.5% of tin.

5. A casting alloy consisting predominantly of copper and containing 2.5% of silicon, 5% of iron, 5% of nickel, 10% of zinc, 0.5% of tin and 0.1% of aluminum.

6. A casting alloy consisting predominantly of copper and containing 2.5% of silicon, 5% of iron, 5% of nickel, 10% of zinc, 0.5% of tin, 0.1% of aluminum and 0.05% of manganese.

In testimony whereof I affix my signature.

DR. EUGEN VADERS.