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COPPER BASE ALLOY

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The alloys of copper, silicon and manganese find extensive commercial application wherever strong corrosion resistant alloys of copper are desired. They cast and hot work easily and are characterized by ready weldability. We have found that their characteristic properties of castability and weldability can be still further enhanced by additions of an alkali metal such as lithium, sodium or potassium. This addition not only gives a more fluid metal, and produces a better surface on the casting, but it also has a marked effect on removing gases and thus makes it easier to obtain castings free from porosity or sponginess.

Because of the high reactivity and volatility of the alkali metals in the elemental state we prefer to make the addition in the form of an alloy with any one or more of the elements tin, cadmium or zinc, none of which elements in reasonable amounts is harmful to the properties of the alloys and, indeed, may be beneficial. Alloys containing between 0.5 and 5 per cent of one or more of these alkali metals in conjunction with either tin or cadmium or zinc, or mixtures of these, are reasonably stable in contact with air, have a melting point lower than the copper-silicon-manganese alloy and are readily added to these alloys without undue oxidization or volatilization loss. These master alloys are readily and safely made by melting the tin, cadmium or zinc and dissolving therein the sodium, potassium or lithium. The amount of this master alloy will be greater than 0.1 per cent and less than 5 per cent of the weight of the copper-silicon-manganese alloy when zinc or tin is used, and not greater than 2 per cent when cadmium is used, because larger amounts of cadmium embrittle the alloy and make it practically impossible to work it either hot or cold. It is sometimes advisable to add a proportion of copper not exceeding 50 per cent to this master alloy to reduce its volatility further.

It is preferable to melt the alloy of copper, silicon and manganese in the customary way, either from scrap or from virgin metal, and then to add the proper amount of the master alloy containing the alkali metal. The amount of alkali metal introduced should be not over .25 per cent and is preferably about 0.02 per cent, but it may be as low as about 0.005 per cent and still produce a material improvement. The amount of tin or zinc in the resultant alloy should not exceed about 5 per cent, or if cadmium is used to carry in the alkali metal not over 2 per cent should remain in the final alloy.

Specific alloys which have been found very satisfactory are as follows:

An alloy containing approximately 3 per cent silicon, 1 per cent manganese, 1 per cent of either zinc or tin; 0.03 per cent of either sodium, lithium or potassium; and balance copper.

Also an alloy containing approximately 3 per cent silicon, 1 per cent manganese, 1 per cent cadmium, 0.02 per cent of either sodium, lithium or potassium; and balance copper.

The addition of alkali metal greatly improves the casting qualities of the metal and makes it easier to obtain sound castings in either metal or sand molds. It has no harmful effect on the ductility of the alloys either hot or cold unless present in excess.

In addition to good casting qualities, the alloy of copper, silicon, manganese and an alkali metal possesses qualities that make it particularly adapted to modern methods of fabrication.

The alloy may be hot or cold rolled, hot or cold extruded, hot or cold forged, hot or cold pressed, hot or cold drawn. Very desirable castings may also be made from this composition when the fluid metal is cast in sand molds or permanent or chill molds. Die castings may also be made. The alloy may be produced in the form of wire, cables, rods, sheets, tubes, pipe, shapes and various formed articles made from these various items.

The composition is relatively free from season cracking and has a high resistance to corrosion, both atmospheric corrosion and general corrosion. The alloy may be used in chemical works where high resistance to corrosion and wear are required. Exact details would depend, of course, on the exact type of corrosion and wear.

The alloy may be readily machined and also roll threaded. The composition may be made into bolts, screws, nuts, etc., where bending, forming, heading, hot or cold, are required.

Welded fabricated structures may also be made from the composition, which may be welded electrically in an autogenous manner, also spot welded or brazed. The fabricated structures may also be made by gas welding, autogenous welding or brazing. Fabricated structures may be made by soldering. This alloy is particularly desirable from the standpoint of welding since it is practically self-fluxing and may be joined either by resistance arc or flame welding with a filler rod of similar or different material.

It is obvious that this alloy may be used for all purposes in which wires, cables, rods, sheets, tubes, pipes, shapes and formed articles are ordi-

narily used. We wish to emphasize, particularly, that the material may be used for ammunition cases and shells of all descriptions, any drawn articles, any spun article, any formed or stamped article.

This alloy has at least as high a resistance to corrosion, disintegration, etc., as copper, brass and other copper alloys and consequently may be substituted in making the articles usually produced from copper and its alloys. It has high resistance to corrosion in the atmosphere and in both hot and cold, fresh and salt water.

The alloy is particularly suited for making springs, both from wire and rods as well as strips and sheets.

In addition to welding readily, both electrically and by the gas method, the alloy makes very desirable welding or filler material for both electric and gas welding, also made into powder for brazing. Sometimes such material is termed electrodes, welding rods, filler rods, brazing rods, brazing solder, etc. The alloy also responds to heat treatment. It is particularly good in welding iron and steel, cast iron and other iron alloys.

Wire may be woven into screens or similar materials, such as Fourdrinier wire cloth or insect screens.

The alloy may be used in coating other metals such as to make duplex metal.

The alloy may be colored or coated itself by electrical or chemical methods or a combination of both.

In short the alloy is suitable for any application wherein its strength, ductility and corrosion resistance is of advantage. It takes on a good polish and is of attractive color and appearance.

In cases where high machinability is desired, additions of 0.01 to 1 per cent of lead, sulphur, selenium or tellurium may be made. Lead additions render the alloy hot short but the additions of sulphur, selenium, or tellurium have no such effect.

Because of the rapid volatilization of the sodium it is essential to add it in the form of a master alloy as above disclosed. Potassium and lithium may, however, be added in the elemental form without much loss and in this case the presence in the alloy of zinc, cadmium, or tin is not necessary. The element potassium has been found to be the most effective of the group in improving the fluidity of the molten metal. Compositions which we have found to be particularly desirable are: Silicon 3.0%, Manganese 1.0%, Potassium 0.03%, balance copper; and another Silicon 3.0%, Manganese 1.0%, and Lithium 0.03%, balance copper. However, the amount of lithium or potassium may vary between 0.005 and 0.25% as described above.

Having thus set forth the nature of our invention, what we claim is:

1. A copper base alloy characterized by being workable both hot and cold containing 0.1 to 5 per cent silicon, 0.1 to 5 per cent manganese, 0.005 to 0.25 per cent of an alkali metal from the group consisting of lithium and potassium; and balance copper.

2. A copper base alloy containing approximately 3 per cent silicon, 1 per cent manganese, 0.02 per cent of an alkali metal from the group consisting of lithium and potassium, and balance copper.

3. A copper base alloy containing 0.1 to 5 percent silicon, 0.1 to 5 percent manganese, 0.005 to 0.25 percent of an alkali metal from the group consisting of sodium, lithium and potassium, and balance substantially all copper or copper and not over 5 percent of a carrier metal for the alkali metal.

4. A copper base alloy containing approximately 3 percent silicon, 1 percent manganese, 0.02 percent of an alkali metal from the group consisting of sodium, lithium and potassium, and balance substantially all copper or copper and not over 5 percent of a carrier metal for the alkali metal.

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