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CONSTANT CONDUCTIVITY ALLOYS

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2 Claims

ABSTRACT OF THE DISCLOSURE

Constant conductivity alloys containing 70–90 weight percent of a metal selected from the group consisting of platinum, rhodium, iridium, palladium, gold, and silver; 7–23 weight percent tungsten, and 2–8 weight percent rhenium. These alloys possess a greater degree of constant electrical conductivity over a wider temperature range than prior art alloys.

Prior-art constant conductivity alloys, in general, must be confined to a narrow range of temperatures in order to exhibit constant conductivity. Even within this narrow temperature range, undesirable deviations may be detected in the conductivity of the prior-art alloys. The prior-art alloys of 97.9% gold-2.1% chromium; 84% copper-12% manganese-4% nickel (manganin); and 60% copper-40% nickel (constantan) must be employed within a narrow range of a few centigrade degrees of ambient temperature in order to exhibit a degree of constant conductivity. Other attempts to produce constant electrical conductivity materials have involved the use of composite structures in which the conductivity changes that occur in different parts of the structure counteract each other giving an overall constant conductivity to the structure.

Alloys according to this invention, are ternary alloys comprising a major proportion of a metal selected from the group consisting of platinum, rhodium, iridium, palladium, gold, or silver, which is alloyed with a minor proportion of tungsten, and a minor proportion of rhenium. These ternary alloys exhibit only slight deviation in conductivity over temperatures ranging from 70 to 500° K. Constant conductivity with no deviation has been obtained over a temperature range of 100° K. to about 220° K. using these alloys.

While alloy formation may be accomplished by melting the three separate metals, a shorter way takes advantage of available alloys containing tungsten-25% rhenium. By using the tungsten-rhenium alloy, preparation of the constant conductivity alloys is somewhat simplified since the melting and solution of only two solid ingredients is necessary. Thus, alloy production simply constitutes the melting of 70% to 90% by weight of one of the noble metals with 10 to 30% by weight of the tungsten-25% rhenium alloy. Alloy preparation is accomplished by standard art procedures. The metal components are placed in a water-cooled copper crucible and melted in an electric-arc furnace under an inert gas. To improve alloy homogeneity, the alloy specimens are remelted several times.

The following table shows a comparison between prior-

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art constant conductivity alloys and the constant conductivity alloy of this invention.

Material	Temperature-independent resistivity value, microhm-cm.	α (° C.) ⁻¹ *	Temperature range for α value ° K.
70% Pt-22.5%W-7.5% Re	11,200	~0	100–220
97.9% Au-2.1% Cr	32	0.1×10^{-6}	291–308
84% Cu-12% Mn-4% Ni (manganin)	45	10×10^{-6}	near 298
60% Cu-40% Ni (constantan)	44	8×10^{-6}	near 298

$$* \alpha = \frac{1}{\rho} \frac{d\rho}{dT}$$

ρ = resistivity of sample material (ohm-cm.).
T = Temperature (° K.).

From the table it is seen that the temperature range over which the resistivity of the new alloy remains constant is much more extensive than that of competitive alloys. The α -values for the competitive alloy are seen to be applicable only to a narrow temperature range. If a wider temperature range is considered for the competitive alloys, then the average α -values also increase. Furthermore, because of high resistivity, it will be possible to make with alloys of this invention, small compact constant conductivity components which will minimize stray electromagnetic interactions.

Ductility of these ternary alloys is widely variant. Heat treatments may be employed to increase the ductility of the alloys. Where this heat treatment is not desirable because of adverse effects on the electrical properties, constant conductivity devices may be fabricated by standard art techniques of painting a slurry of the alloy components on a ceramic substrate and heating to produce alloy formation.

Alloys of this invention may be soldered, brazed, and welded to all forms of electrical conductors by standard art techniques.

I claim:

1. A constant conductivity ternary alloy consisting essentially of 70–90 weight percent of a metal selected from the group consisting of platinum, rhodium, iridium, palladium, gold, and silver; 7–23 weight percent tungsten; and 2–8 weight percent rhenium, the alloy possessing a relatively constant conductivity over a temperature range of from about 70° to about 500° K.

2. An electrical resistor comprising an alloy consisting essentially of 70 weight percent platinum, 22.5 weight percent tungsten, and 7.5 weight percent rhenium, the alloy possessing a relatively constant conductivity over a temperature range of from about 70° to about 500° K.

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