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ELECTRIC HEATING ELEMENT

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4 Claims. (Cl. 201—76)

This invention relates to electric resistance heating elements, such as furnace windings (hereinafter termed heating resistors) constructed of platinum alloys having improved characteristics.

It has hitherto been usual to employ pure platinum or platinum alloys containing rhodium for the purpose of forming the heating resistors of electric resistance furnaces for operation at temperatures up to about 1650° C. For these, and similar, applications the rhodium-platinum alloys have the advantage that their temperature coefficients of resistance are appreciably lower than that of pure platinum. The values for the temperature coefficient of resistance of 10% rhodium-platinum alloy and of pure platinum are 0.0013 and 0.0039 per degree centigrade respectively over the range from 0 to 100° centigrade. As a result, the resistance of a furnace wound with 10% rhodium-platinum alloy does not increase to such an extent as that of one wound with pure platinum as the temperature is raised; the furnace wound with 10% rhodium-platinum alloy is easier to control; it requires less attention during the initial stages of heating; and it does not require to have so large an external resistance connected in series with it for satisfactory operation.

I have now found that the alloys of platinum with from 1 to 20% of ruthenium by weight have values of temperature coefficient of resistance which are very much smaller than those of the corresponding rhodium-platinum alloys and have characteristics which make them very well adapted for the construction of electric heating resistors such as furnace elements.

I am aware that ruthenium-platinum alloys are widely used for jewelry and other purposes for which the fact that they have a greater hardness than pure platinum is a desirable characteristic. Their use for electrical heating purposes is believed to be novel and in this connection it should be noticed that it has frequently been reported that platinum alloys containing more than about 10% of ruthenium are unworkable, and also that it has generally been considered that the ruthenium-platinum alloys are unsuitable for operation at high temperatures in view of the volatility of the oxides of ruthenium. I have now found that, with proper precautions, it is possible to prepare with ease wires of the ruthenium-platinum alloys containing up to 15% of ruthenium and, with care, to produce and work alloys containing up to 20% of ruthenium. Furthermore, I have found that no appreciable change occurs in the composition of the alloys when they are made into the form of heating resistors such as furnace

windings, protected with a suitable refractory cement, and heated for long periods at elevated temperatures.

As an example, an alloy containing 5% ruthenium and the balance platinum was made by melting together the highly purified constituents in a lime furnace. It is necessary that the constituent metals should be in a highly purified state since the impurities which are found in many commercial grades of the metals tend to increase the difficulties of working the alloy. With this treatment a sound ingot was obtained which was readily worked down to the form of wire. Measurements of the electrical resistance of the wire at 0° centigrade and 100° centigrade revealed that the average temperature coefficient of resistance between these two temperatures was only 0.00089, which is less than $\frac{2}{3}$ of that of the 10% rhodium-platinum alloy. Alloys containing greater amounts of ruthenium were found to have still lower values of temperature coefficient of resistance, as shown in the following table:—

Alloy:	Temperature coefficient of resistance per °C.
10% ruthenium, balance platinum----	0.00046
14% ruthenium, balance platinum----	0.00036

The value of the 5% ruthenium-platinum alloy for the purpose of forming a heating resistor was shown by the results of tests on a tubular furnace in which the heating resistor was composed of a length of 5% ruthenium-platinum alloy wire, 0.020 inch in diameter, wound over a refractory tube 1.0 inch in diameter.

The resistance of the furnace was found to be 4.63 ohms at 18° C., and increased to only 9.7 ohms when the temperature of the furnace was raised to 1500° C. If the furnace had been wound with 10% rhodium-platinum the resistance at 1500° C. would have been about 15.7 ohms, and if wound with pure platinum 23.15 ohms.

The furnace was operated continuously at 1500° C. and at the end of 144 hours, when the test was stopped, it was in excellent condition and the resistance of the winding had increased only to 10.9 ohms. This change of resistance is no greater than occurs with windings of pure platinum or rhodium-platinum and is probably largely due to volatilisation of the winding. Half the increase occurred during the first 24 hours of operation, and it is evident that no appreciable loss of ruthenium occurred by oxidation.

I claim:

1. An electric furnace resistor having a low temperature coefficient of resistance comprising

a platinum-ruthenium wire containing from 1 to 20% of ruthenium.

2. An electric furnace resistor having a low temperature coefficient of resistance comprising a platinum-ruthenium wire containing 5% ruthenium.

3. An electric furnace resistor having a low temperature coefficient of resistance comprising a

platinum-ruthenium wire containing 10% ruthenium.

4. An electric furnace resistor having a low temperature coefficient of resistance comprising a platinum-ruthenium wire containing 14% ruthenium.

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