

1

3,749,569

ELECTRICAL RESISTANCE ALLOYS

Carrol Dean Starr, Whippany, Robert Steinitz, Montclair,
and Teh Po Wang, North Caldwell, N.J., assignors to
Wilbur B. Driver Company

No Drawing. Filed July 22, 1971, Ser. No. 165,318

Int. Cl. C22c 19/00

U.S. Cl. 75—170

2 Claims

ABSTRACT OF THE DISCLOSURE

Oxidation resistant electrical resistance alloys are disclosed that have a *nickel base* and contain from 0.5 to 5% by weight of silicon, and 0.01 and 0.04% by weight of calcium and from about 50 p.p.m. to 180 p.p.m. by weight of oxygen in the form of silicon dioxide (SiO_2) and calcium oxide (CaO) in the molar ratio SiO_2 to CaO of less than one. A method for making the alloy is disclosed. These alloys are electrical resistance alloys which have uniform long life under oxidizing conditions.

CROSS-REFERENCE TO CO-PENDING APPLICATIONS

In co-pending U.S. patent application Ser. No. 128,919, filed Mar. 20, 1971, a continuation-in-part of Ser. No. 776,621 filed Nov. 14, 1968, now abandoned, nickel base electrical resistance alloys having an improved life were disclosed containing from 3.5 to 5% silicon and 0.02% to 0.3% calcium and the balance nickel. This co-pending application is assigned to the same assignee as the present application.

BACKGROUND OF THE INVENTION

The alloys disclosed in Ser. No. 128,919 were an advancement over the art, however, as disclosed therein, some had longer life than others and the range of silicon and calcium was quite narrow. For example, as disclosed in that application, the operating life varied from 80 hours to 760 hours.

It is believed that an improvement to such alloys which reproducibly yield long life and enables more flexibility in control of the alloy ingredients is an advancement in the art.

SUMMARY OF THE INVENTION

In accordance with one aspect of this invention, there is provided an electrical resistance alloy consisting essentially of

	Percent by weight
Silicon	0.5 to 5
Calcium	0.01 to 0.04
Nickel	Balance

and from 50 to 180 p.p.m. of oxygen in the form of CaO and SiO_2 in a molar ratio of SiO_2 : CaO of less than 1. Such alloys have a life of greater than 100 hours under cyclic tests given hereinafter. These alloys can be prepared by forming the melts in a vacuum of less than 0.1 mm. Hg, under a reducing atmosphere or in air with suitable deoxidization practice.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

For a better understanding of the present invention, together with other and further objects, advantages and capabilities thereof, reference is made to the following disclosure and appended claims in connection with the above description of some of the aspects of the invention.

2

Although the exact mechanism for the improved alloys is not completely understood, it has been found that silicon dioxide (SiO_2) and calcium oxide (CaO) are agglomerated at the interface between the oxide scale and the metal wire. Also, it has been found that as the molar ratio of SiO_2 : CaO is above 1 or insufficient oxygen is present for the formation of CaO , life of the alloy decreases due to the increased oxidation rate of the alloy. Since the range of Ca in the alloy is within a relatively narrow range, generally from about 50 to about 180 p.p.m. of oxygen yields the desired CaO formation without an excessive amount of silicon dioxide. A preferred alloy comprises, in addition to nickel, from 3.5 to 4.2% by weight silicon, 200 to 300 p.p.m. calcium and from 100 to 150 p.p.m. oxygen.

In general, the production of the alloys is via melting and rolling techniques known in the art with the exception that the melt portion of the process is conducted under controlled conditions which prevents excess oxygen in the alloy. In general, the overall process involves melting the various alloy forming ingredients and minor amounts of additives can be used at this stage for various purposes if desired, for example, deoxidizers such as carbon and the like. Thereafter, the melt is solidified into ingots, it is hot rolled and cold worked to form the desired shape such as wire or strip. The conditions during the melt step are important since oxygen in the atmosphere can raise the SiO_2 : CaO molar ratio above 1 which can prevent the advantages of this invention from being attained. Suitable atmospheres include a vacuum pressure of less than about 0.1 mm. Hg, a reducing atmosphere such as hydrogen and cracked ammonia, a mixture of nitrogen and hydrogen. Additionally an air atmosphere can be used with suitable deoxidation practices known in the art.

The alloys of this invention have a life of greater than 100 hours under the cyclic life test given in ASTM Standard Test of B76-65 at 2175° F.

While there has been shown and described what is at present considered the preferred embodiments of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the scope of the invention as defined by the appended claims.

What is claimed is:

1. An electrical resistance alloy consisting essentially of nickel and from about 0.5 to about 5% by weight of silicon and from about 0.01 to about 0.04% by weight of calcium and from about 50 to about 180 p.p.m. by weight of oxygen in the form of calcium oxide and silicon dioxide in a molar ratio of SiO_2 : CaO less than one.

2. An alloy according to claim 1 wherein said silicon content is from about 3.5 to 4.2% by weight, said calcium is from about 200 to about 300 p.p.m. by weight and said oxygen is from about 100 p.p.m. to about 150 p.p.m. by weight.

References Cited

UNITED STATES PATENTS

1,076,438	10/1913	Marsh	75—170
2,005,423	6/1935	Hunter	75—170
2,019,686	11/1935	Lohr	75—170
2,019,686	11/1935	Lohr	75—170
2,159,048	5/1939	Bessemer	75—170
3,367,773	2/1968	Tarillon	75—170

HYLAND BIZOT, Primary Examiner