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CORROSION RESISTANT ALLOYS

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3 Claims. (Cl. 75—171)

This invention relates to corrosion resistant nickel-chromium alloys.

For certain purposes alloys are required which have high heat resistance and also corrosion resistance, as for example, in the manufacture of conveyor chains, which have to carry goods through a furnace for annealing or other heat treatment and then through a spray which may consist of a dilute solution of one or more acids. Although the corrosion resistance of the straight nickel-chromium alloys is quite good, it may, in examples such as that above referred to, be the corrosion resistance which determines the life of the alloy rather than the heat resistance, and the present invention is concerned with improving such corrosion resistance.

The invention comprises the addition to nickel-chromium alloys of from 3% to 6% of silicon. The best results appear to be achieved when the addition of silicon is approximately 4%.

The nickel-chromium alloy may contain from 10% to 30% of chromium. The remainder of the alloy may be nickel save for the silicon. The nickel content may be partly replaced by iron, cobalt, tungsten, vanadium, molybdenum, zirconium, manganese and uranium. The alloy may also contain traces of alkaline earth metals, or the rare earth metals, and may also contain the usual small quantities of impurities of such elements as carbon, sulphur, phosphorus and aluminium.

Experimental tests have shown that a silicon addition within the range 3–6% reduces the attack of acid upon nickel-chromium alloys to a considerable extent.

For this purpose four series of tests were made, each upon six pieces of metal of two different compositions as follows:

1	Per cent	2	Per cent
Chromium	25	Chromium	20
Silicon	4	Silicon	1
Nickel	Balance	Nickel	Balance

No. 1 being taken as an example of the preferred alloy and No. 2 as an example of a known alloy in use to-day for such purposes.

The metal pieces in each case had the following approximate dimensions:

(1) Heavy strip 6 inches x 0.5 inch x .125 inch
(2) Light strip 3 inches x 0.25 inch x .020 inch
(3) Round wire 8 inches x .057 inch diameter

Each sample was fastened by a wire of the same composition as the sample, to the periphery of a fibre disc partly immersed in the test liquid and revolved once every four minutes. A given point on any specimen was immersed for one minute. The evaporation loss was continuously replaced by boiled water and the liquid was continuously stirred. In two series of tests the liquid contained 2½% by weight of sulphuric acid and the liquid temperatures were room temperature and 60° C. In two other series of tests, the liquid contained 5% by weight of sulphuric acid and the liquid temperatures were room temperature and 60° C.

It should be remarked that it is a matter of general knowledge that the difference in corrosion resistance of nickel chromium alloys is not attributable to relatively small differences in chromium content. It can be attributed therefore in the following test figures to differences in silicon content.

Test results

		Heavy strip breaking load, pounds	Light strip breaking load, pounds	Wire breaking load, pounds
Original material	Low silicon	5,936	648	319
	High silicon	7,250	698	372
TESTS IN 2½% H_2SO_4 FOR 500 HOURS				
Room temperature	Low silicon	5,895	630	310
	High silicon	7,180	690	362
60° C.	Low silicon	5,130	485	276
	High silicon	6,940	697	351
TESTS IN 5% H_2SO_4 FOR 500 HOURS				
Room temperature	Low silicon	5,890	506	235
	High silicon	7,140	660	350
60° C.	Low silicon	3,330	435	176
	High silicon	6,760	634	282

The above results show the marked superiority of the high silicon alloy particularly under the more exacting conditions.

What I claim is:

1. A heat resistant, corrosion resistant alloy capable of being worked into strip or wire form consisting essentially of 10 to 30 percent chromium, 3 to 6 percent silicon, balance nickel.

2. A heat resistant, corrosion resistant alloy capable of being worked into strip or wire form consisting essentially of substantially 20 percent chromium, 3 to 6 percent silicon, balance nickel.

3. A heat resistant, corrosion resistant alloy capable of being worked into strip or wire form consisting essentially of substantially 20 percent chromium, substantially 4 percent silicon, balance nickel.

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