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ALLOY.

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The invention relates to alloys of nickel and molybdenum containing considerable quantities of iron, and minor quantities of silicon, manganese, carbon and other elements. The alloys of the invention are particularly valuable for their acid-resisting properties but they are also adapted for uses where acid-resistance is not essential.

Alloys of this type are disclosed in Patents 1,375,082 and 1,375,083 to Clement. The patentee was aware of the acid-resisting properties of the alloys, and apparently regarded an alloy containing nickel 90% and molybdenum 10% as the optimum composition, although he observed that up to 10% of iron could be added without destroying the useful properties.

I have discovered that much better acid-resistance can be obtained by increasing the molybdenum beyond the proportion recommended by Clement, and I have found it possible, by using a proper proportion of molybdenum, to make alloys which contain 20% or more of iron and still show better acid-resistance than the alloys disclosed by Clement.

The alloys of my invention are resistant to hydrochloric acid and to sulphuric acid, but are attacked by nitric acid. There is no increase in acid resistance obtainable by raising the molybdenum above about 40%, or at least none sufficient to warrant the cost of the higher molybdenum content.

The molybdenum can be most cheaply introduced into the alloy as ferromolybdenum, but this material can only be used where the final alloy is not too much impaired by the iron so introduced. I find that alloys containing 15% or more of molybdenum give a tolerance for iron sufficient to warrant their preferment. With the molybdenum at or above 18% the alloy may contain substantial quantities of iron and still show excellent acid-resistance; higher in fact than iron-free alloys containing less than 15% molybdenum. Giving due consideration to cost and properties I regard a molybdenum content of about 20% as the most desirable one.

A series of carefully prepared and analyzed alloys were tested in the forged condition for resistance to 10% HCl at 70° C. These alloys had the following approximate composition:

	Per cent.
Mo	20
Ni+Fe	77
Mn	2.2
V	0.3
Si	0.2
C	0.2

The iron content was varied through a number of values in the test. The acid-resistance was found to fall off as the iron content increased—the decrease in acid-resistance being slow until the iron content reached about 35%. All the alloys with less than 35% iron had acceptable acid-resistance, the weight loss in this test not exceeding 0.00015 grams per square centimeter per hour for any of the samples within this range.

I prefer that the percentage of iron present shall not be greater than five times the amount by which the molybdenum percentage exceeds 10. Thus, with a molybdenum content of 15% the iron may be as high as 25%, while with molybdenum 18% the iron may be as high as 40%. My tests indicate, however, that the nickel content should not fall below 40%. With the molybdenum in the higher ranges the permissible iron content is limited by this consideration rather than by the relation of iron to molybdenum stated above. The preferred content of iron is still lower—not more than 30% even with the optimum molybdenum for high iron content. The preferred molybdenum range is 18% to 25%.

The herein described alloys exhibit high tensile strength, and are tough and malleable. They can be worked by forging, rolling and like operations, and can be readily machined. The presence of manganese improves the workability but the manganese content should not exceed 4%, and 1% to 2.5% is usually suitable.

Silicon increases the fluidity of the molten metal, and up to about 1.5% may be incorporated into alloy which is to be used in the cast form. However, working of the alloy will usually be contemplated, and in that case

the silicon should be below 1.0% and preferably below 0.5%. The carbon content should not much exceed 0.5% and is preferably below 0.3%. Vanadium is valuable as a scavenger. Additions which leave about 0.3% V in the alloy give good results. Other scavengers or deoxidizers may be used. The alloy may of course contain sulphur, phosphorus and other incidental impurities in the usual quantities.

I claim:—

1. An alloy consisting essentially of nickel, molybdenum and iron; containing nickel at least 40%, molybdenum 15% to 40%; and a percentage of iron not less than 10% nor greater than five times the amount by which the molybdenum percentage exceeds 10.

2. An alloy consisting essentially of nickel, molybdenum and iron; containing nickel at least 40%; molybdenum 18% to 40%; and not less than 10% nor more than 30% of iron.

3. An alloy containing molybdenum 18 to 25%, and iron between 10% and 30%, with the balance chiefly nickel.

In testimony whereof, I affix my signature.

FREDERICK M. BECKET.