The replacement of nickel for cobalt alters the hardness value at room temperature only to a slight extent, from approximately Rockwell C 54-55 for the nickel-free alloy or alloys with a low nickel content to Rockwell C 52-54 for alloy 1 containing 10% nickel and 50-52 Rockwell C for alloy 2 containing 20% nickel. For this reason an appreciable reduction of the wear resistance as a result of the replacement of nickel for cobalt is not to be expected.

Alloys 1, 2 and 3 in as-cast and as-welded states were subjected to weight loss tests at room temperature and boiling temperature in 10% hydrochloric acid, and 20% sulfuric acid, and 30% nitric acid. The results of these tests are compiled in Table 2.

A comparison of these weight losses with those of the nickel-free alloys as stated in Table 3 of the above-noted patent shows that the addition of nickel results in a further increase of the corrosion resistance. On an average, the patent shows that between 2.5% and 20% nickel results in a decrease of the weight losses to between one half and one third in hydrochloric, sulfuric acid, and nitric acid.
An alloy having a composition of 2.2% carbon, ≤1% silicon, ≤1% manganese, 30% chromium, 14% tungsten, 10% nickel, 36% cobalt, 4% molybdenum, and 2% copper appears to be most suitable for practical use as a corrosion-resisting hard alloy containing copper, molybdenum and nickel.

A somewhat larger corrosion-resisting effect is achieved with a nickel content below 10%.

A similarly favorable result was achieved with alloys having a medium wear resistance by an addition of nickel.

The analysis ranges of such hard alloys are 0.7–2.2% carbon, 0–2% silicon, 0–1% manganese, 25–35% chromium, 3–12.9% tungsten, 2.5 to 10% nickel, 0–6% molybdenum, 0.2–6% copper, balance cobalt.

An alloy having the following composition has been found to be particularly desirable:

1.2% carbon, 1.1% silicon, 0.15% manganese, 30% chromium, 4% tungsten, 7% nickel, 3.3% molybdenum, 1.6% copper, balance cobalt.

A comparison of the weight losses in hydrochloric and sulfuric acids shows that in the hard alloys of this type, having a medium wear resistance owing to reduced carbon and tungsten contents, the addition of copper, molybdenum and nickel results in the same high corrosion resistance as in a hard alloy having a high wear resistance owing to higher carbon and tungsten contents. The alloys tested had the following composition:

(a) Alloy of medium wear resistance: 1.20% carbon, 1.0% silicon, 0.09% manganese, 27.7% chromium, 4.9% tungsten, 6.0% nickel, 3.43% molybdenum, 1.48% copper, 0.35% iron, balance cobalt.

(b) Alloy of high wear resistance: 2.23% carbon, 1.28% silicon, 0.08% manganese, 27.1% chromium, 13.5% tungsten, 6.1% nickel, 3.53% molybdenum, 1.50% copper, 0.7% iron, balance cobalt.

Weight losses in g/sq. m/h. of alloys (a) and (b) in hydrochloric, sulfuric and nitric acids.