levels in the sintered articles as stated in Tables 2 and 3. In one instance a mix of 20% HC23 and 80% 316L was prepared.

The blends of powder were pressed using conventional powder metallurgy presses and tooling to produce compacts with various densities. The samples prepared were cylinders 6 mm in diameter and 16 mm long for pin and disc wear testing and rectangular blocks 78 mm×10 mm×6.5 mm for corrosion testing.

The samples were sintered at temperatures between 1100 and 1250 degrees centigrade for between 20 minutes and 1 hour in a vacuum, in a mixture of 50% nitrogen 50% hydrogen gas, or in pure hydrogen gas. Cooling after sintering was at a rate between 10 and 20 degrees centigrade per minute.

Comparative Wear Testing

Cylinders for wear testing were sintered for 30 minutes under vacuum and were cooled at an estimated rate of 20 degrees centigrade per minute.

Wear testing was carried out by pressing the circular end of a wear test pin onto a rotating disc of 52100 steel hardened to 60/62 HRc with a load of 10 kg. The disc was rotated at a variety of speeds and the relative motion of the pin and disc calculated.

In this type of test, low rates of pin wear are found at low speeds but as the speed increases the rate of wear undergoes a change to rapid wear at a characteristic speed known as the T1 transition. The higher the T1 transition speed the better is the wear resistance of the test alloy.

The following T1 transition speeds were determined

TABLE 2

T1 Transition speeds for various sintered alloys

Powder	Final carbon weight %	Sintered Density g/cc	T1 transition m/s
316L	0.015	6.95	<0.5
316L + 20% HC23	0.12	6.7	0.75
410	0.15	6.82	1.35
HC23	1.60	6.7	3.05
HC23	2.09	7.0	3.4

Comparative Corrosion Resistance

Rectangular blocks for comparative corrosion testing were prepared from the same powder blends as those used in the wear testing above.

The samples were sintered at a temperature of 1140 degrees centigrade in a 50% nitrogen 50% hydrogen atmosphere for a period of 25 minutes and were subsequently cooled at an estimated rate of 13.5 degrees centigrade per minute. In this experiment the sintered density of the alloys 316L, 316L+20%HC23, and 410 was around 6.6 g/cc and the density of the HC23 alloys was about 6.1 g/cc.

The samples were tested for relative pitting corrosion resistance using the ferroxyl test described in Metal Powder Report, April 1994, pp 42–46. In this test the degree of corrosion that has occurred can be determined by the amount of Turnbull's blue dye that appears in the test solution.

A 0.2% sodium chloride solution was used and the samples left submerged in the corrosion medium for a period of 24 hours at 20 degrees centigrade. At the end of this period the amount of dye present was determined subjectively and the materials ranked in terms of their corrosion resistance as follows:

Most dye, worst corrosion resistance
410
HC23 2.1 wt % carbon
316L & 316L+20%HC23
HC23 1.6 wt % carbon
Least dye, best corrosion resistance

Corrosion Resistance at Various Carbon and Chromium Compositions

In order to test the effect of chromium and carbon content on corrosion resistance. The alloys HC13, HC18, HC23 and HC28 were tested at a variety of final carbon contents.

Rectangular samples were pressed and then sintered in a hydrogen atmosphere for up to 60 minutes. A range of sintering temperatures from 1100 to 1230 degrees centigrade was used to produce a density of around 6.1 g/cc in all samples. The samples were then cooled at an estimated rate of between 10 and 15 degrees centigrade per minute.

At high carbon contents, relative to the chromium content, the corrosion resistance of the alloys deteriorates rapidly due to the formation of significant quantities of austenite. This can be detected within 10 minutes immersion in the ferroxyl test solution. If the sample was seen to corrode within 30 minutes then the corrosion resistance was defined as poor. If no corrosion was detected then corrosion rates were found to remain slow for many hours and the corrosion resistance was defined as good.

The following results were obtained:

TABLE 3

Corrosion resistance as a function of chromium and carbon content

	Final sintered carbon level weight percent					
Alloy	0.59	1.09	1.59	2.09	2.59	3.09
HC13	Poor	NT	NT	NT	NT	NT
HC18	Good	Poor	Poor	NT	NT	NT
HC23	Good	Good	Good	Good	Poor	Poor
HC28	Good	Good	Good	Good	Good	Poor

Good denotes insignificant corrosion in 10 minutes
Poor denotes significant corrosion in 10 minutes
NT denotes that this combination was not tested

We claim:

1. An alloy powder comprising, in weight percent, chromium 14 to 30, molybdenum 1 to 5, vanadium 0 to 5, tungsten 0 to 6, silicon 0 to 1.5, carbon according to the formula set forth below, a strong carbide forming element 0 to 5, the total of Mo, V and W being at least 3, balance iron including incidental impurities;

the alloy powder together with any addition of free graphite powder mixed therewith having a minimum and maximum carbon content according to C_{min}=(%V×0.24)+(2×%Mo+%W)×0.03+(%Nb×0.13)+(%Ti×0.25)+(%Ta×0.066), and

C_{max}=C_{min}+0.3+(%Cr−12)×0.06, such that the powder includes sufficient carbon to form carbides with all the Mo, V, W and the strong carbide forming element present;

the powder being produced by rapid atomisation followed by an annealing treatment such that the powder has a substantially ferritic matrix containing at least 12% of chromium in solution and a dispersion of carbides.

2. An alloy powder comprising, in weight percent, chromium 20 to 28, molybdenum 2 to 3, vanadium 1.5 to 2.5, tungsten 2.5 to 3.5, silicon 0.8 to 1.5, carbon 0.555 to 2, a strong carbide forming element 0 to 5, and if present, requiring additional carbons sufficient to form carbides therewith so as to give C_{min}=(%V×0.24)+(2×%Mo+%W)×0.03+(%Nb×0.13)+(%Ti×0.25)+(%Ta×0.066), and