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TITANIUM BASE ALLOYS CONTAINING
CHROMIUM AND CARBON

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This invention relates to titanium-base alloys and, more particularly, to titanium-base alloys containing chromium and carbon, and is a continuation-in-part of co-pending application, Serial No. 36,434, filed July 1, 1948, now abandoned.

It has become generally recognized that titanium metal possesses valuable properties which render it desirable for various structural uses and for other purposes. For example, the metal has an excellent strength/weight ratio, good corrosion properties, and is useful for high-temperature applications. However, these various properties of titanium are not ordinarily subject to adjustment to meet specific requirements imposed by particular applications. For this reason then, as well as for purposes of improving the properties of the base metal, it is desirable to produce alloys of titanium which will possess desired properties in the required degree, or which will respond to heat treatment, or other methods for enhancing a particular quality (characteristic) or property.

It is accordingly an object of this invention to provide alloys of titanium containing chromium and carbon.

It is another object of this invention to provide titanium-chromium-carbon alloys having desirable properties for structural or other purposes.

Yet another object of this invention is to produce titanium-chromium-carbon alloys which are responsive to heat treatment.

Other objects and advantages of the present invention will be apparent in view of the following detailed description thereof.

In general, this invention relates to alloys of titanium containing chromium and carbon. In particular, the invention relates to titanium alloys containing from about 1.5% to about 7.5% chromium and from about 0.2% to about 0.6% carbon. A preferred range of from 2.5% to 5.0% chromium and 0.25% to 0.5% carbon has also been established.

Titanium-chromium-carbon alloys may be prepared in accordance with present-day melting techniques which form no part of the present invention and need not be discussed further here.

Table I below lists typical values obtained in physical tests of titanium-chromium-carbon al-

loys. Properties listed are the as-hot-rolled values (at 1450° F.).

Table I

Composition ¹			Tensile Strength, p. s. i.	Elonga- tion, percent in 1-in.	V. H. N.
Intended		Actual ²			
Percent Cr.	Percent C	Percent Cr			
2.5	0.25	2.25	141,400	7.5	305
2.5	0.25	2.28	171,200	8.0	336
3.5	0.25	3.23	160,200	5.0	262
5.0	0.25	4.94	179,900	5.0	349
5.0	0.25	4.27	153,100	6.5	288
10.0	0.25	9.40	179,400	3.5	383
15.0	0.25	14.40	171,000	6.0	346
2.5	0.50	2.15	128,200	11.5	245
3.5	0.50	3.35	146,900	7.0	266
5.0	0.50	4.21	155,300	5.0	280

¹ Balance Ti.

² No analysis made for C.

From the table above, it will be apparent that titanium-chromium-carbon alloys in the preferred range possess good tensile properties combined with sufficient ductility to permit ordinary working of the alloys. Furthermore, alloys in the range 1.5% to 7.5% chromium, 0.2% to 0.6% carbon, the balance essentially all titanium, possess these properties, although to a slightly lesser degree. These alloys also have the corrosion resistance and other desirable properties ordinarily imputed to titanium and titanium alloys.

That the alloys of the present invention respond to heat treatment is indicated by the data in Table II, wherein it will be noted that the hardness is generally increased by heat treatment at temperatures in the range 1450° F. to 1750° F., and also by aging at 750° F. for various periods of time ranging from two to twelve hours. The particular heat treatment which effected the hardness changes reported consisted of heating specimens in air for 30 minutes at the designated temperature and then quenching in cold water. Each value reported represents the average of at least five readings taken at the center of a cross-section perpendicular to the direction of rolling.

Table II

Composition				V. H. N. as Hot- Rolled	Anneal, 1,450° F.	Vicker's Hardness Number After Heat Treatment ² At—						V. H. N. as Hot-Rolled and Aged at 750° F. for—				
Intended		Actual				1,450° F.	1,550° F.	1,600° F.	1,650° F.	1,700° F.	1,750° F.	0 Hours	2 Hours	4 Hours	8 Hours	12 Hours
Percent Cr	Percent C	Percent Cr	Percent C													
2.5	0.25	2.25	----	305	-----	301	318	314	327	339	369	305	----	318	----	-----
2.5	0.25	2.28	0.28	336	304	307	-----	-----	-----	-----	377	326	354	363	365	327
3.5	0.25	3.23	-----	262	-----	312	332	320	321	319	380	262	-----	345	-----	-----
5.0	0.25	4.94	0.25	349	353	386	-----	-----	-----	-----	392	353	383	387	398	352
5.0	0.25	4.27	-----	288	-----	310	376	303	309	312	314	288	-----	357	-----	-----
10.0	0.25	9.40	0.28	383	443	326	-----	-----	-----	-----	333	376	506	503	482	456
15.0	0.25	14.40	0.13	346	337	334	-----	-----	-----	-----	370	317	465	459	488	427
2.5	0.5	2.15	-----	245	-----	257	291	294	297	306	302	245	-----	301	-----	-----
3.5	0.5	3.35	-----	266	-----	296	295	277	311	313	335	266	-----	321	-----	-----
5.0	0.5	4.21	-----	280	-----	355	305	301	352	446	366	280	-----	355	-----	-----

¹ Balance titanium.² Held at indicated temperature for 30 minutes and quenched in cold water.

It will now be apparent that new and useful alloys of titanium, chromium, and carbon have been described wherefore it will be obvious to those skilled in the art that certain slight changes may be made without departing from the scope of this invention which is hereinafter defined in the claims.

What is claimed is:

1. An alloy consisting essentially of from about 1.5% to about 7.5% chromium, from about 0.2% to about 0.6% carbon, and the balance titanium, said alloy being characterized by having a minimum tensile strength of about 128,200 p. s. i. and a minimum elongation of about 5.0% in the as-hot-rolled (at 1450° F.) condition.

2. An alloy consisting of from about 2.5% to about 5.0% chromium, from about 0.25% to about 0.50% carbon, and the balance titanium.

References Cited in the file of this patent

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