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FERROUS ALLOYS AND ABRASION RESISTANT ARTICLES THEREOF

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This invention relates to ferrous articles and abrasion resistant articles thereof and particularly to an inexpensive abrasion resistant alloy which is readily workable and castable. The present invention provides an alloy which is not only abrasive resistant but has excellent impact strength and hardening ability. Such steels have long been sought for fabrication into tools, dies and wear parts which are subject to abrasion and shock and must be frequently redressed and sharpened. We have found that such an alloy can be produced without any of the high cost alloys previously thought indispensable.

Our alloy provides an abrasion resistant readily forgeable and/or cast alloy which has all of the foregoing qualities. The alloy of our invention is the result of a proper combination of carbon in an amount in excess of that necessary to give the desired hardening ability combined with titanium and vanadium in proportions such that the excess carbon equals

$$\frac{V-1}{4.2}+\frac{Ti}{4}$$

said titanium being present in at least 0.5%.

Broadly stated, the composition of our invention may have the general composition range of:

	Percent
C	About 1 to 4.25
Si, max.	About 1.5
Mn, max.	About 1.5
Cr	About 3.5 to 9.5
Ti	About 0.5 to 5
V	<5
Mo	<2
W	<3
Co	<5
Ni	<3
S	Up to 0.25

Balance substantially iron with residual impurities in ordinary amounts, said titanium being combined with carbon in excess of that needed to give desired hardenability in a weight ratio of 4:1.

A single preferred composition of our invention for most applications has the composition:

	Percent
C	About 2.7
Cr	About 5
Si	About 0.3
Mn	About 0.7
Mo	About 1
Ti	About 2.5

Balance substantially iron with residual impurities in ordinary amounts, said titanium being combined with carbon in a weight ratio of 4:1.

The silicon and manganese ranges are not critical and

may vary within reasonable limits from those set out in the broad composition range hereinabove set out. The expression "less than" followed by a percentage figure for nickel, molybdenum, tungsten, cobalt and vanadium means that the particular element may be entirely absent or may be present up to the concentration given without deleteriously affecting the alloy.

Several heats of steel were made according to our invention with the composition set out in Table I and compared with what we believe is the best prior art alloy for the service here indicated. These compositions were as follows:

TABLE I

	C	Si	Mn	P	S	Cr	Mo	Ti	V
WR 51	2.64	0.32	0.93	0.007	0.003	5.88	1.02	2.38	----
WR 52	2.70	0.36	1.08	0.005	0.005	4.75	1.07	4.66	----
WR 68	2.70	0.28	0.76	----	----	5.80	1.00	2.39	----
WR 69	2.86	0.32	0.75	0.004	0.007	5.58	1.08	2.74	1.52
WR 70	3.18	0.31	0.76	0.003	0.005	5.69	1.02	3.80	----
Prior Art	2.8	0.30	0.70	----	----	5.0	1.10	----	4.50

Abrasion tests were carried out on these alloys by directing #70 aluminum oxide grit at constant velocity for 10 minutes at an angle of 90° against a wear surface dimension of 1¼" x 2" and the weight loss determined. The results of these tests appear in Table II.

TABLE II

Alloy	Average Percent Weight Loss	Hardness Rc
WR 51	3.34	64.9
WR 52	2.81	64.7
WR 68	3.41	65.2
WR 69	3.48	64.3
WR 70	3.41	64.2
Prior Art	3.62	64.8

It will be seen from the foregoing table that the alloy of our invention suffered less percent weight loss than the prior art alloy containing a relatively large amount of expensive vanadium.

While we have described and disclosed certain preferred embodiments of our invention in the foregoing specification, it will be understood that this invention may be otherwise embodied within the scope of the following claims.

We claim:

1. An abrasion resistant readily workable and castable alloy of high impact properties consisting essentially of carbon about 1% to 4.25%, silicon about 1.5% maximum, manganese about 1.5% maximum, chromium about 3.5% to 9.5%, molybdenum less than about 2%, tungsten less than about 3%, cobalt less than about 5%, nickel less than about 3%, vanadium less than about 5%, sulfur up to about 0.25%, titanium about 0.5% to 5% and the balance iron with usual impurities in ordinary amounts, said titanium being combined with carbon in excess of that necessary to provide a desired hardening ability in a weight ratio of 4:1 and the vanadium with excess carbon in a weight ratio of 4.2 (V–1):1.

2. An abrasion resistant readily workable and castable alloy of high impact properties consisting essentially of carbon about 2.7%, silicon about 0.3%, manganese about 0.7%, chromium about 5%, molybdenum about 1%, sulfur up to about 0.25%, titanium about 2.5% and the balance iron with usual impurities in ordinary amounts, said titanium being combined with carbon in excess of that necessary to provide desired hardening ability in a weight ratio of 4:1.

3. An article made from a ferrous base metal consisting essentially of carbon about 1% to 4.25%, silicon about 1.5% maximum, manganese about 1.5% maximum,

chromium about 3.5% to 9.5%, molybdenum less than about 2%, tungsten less than about 3%, cobalt less than about 5%, nickel less than about 3%, vanadium less than about 5%, sulfur up to about 0.25%, titanium about 0.5% to 5% and the balance iron with usual impurities in ordinary amounts, said titanium being combined with carbon in excess of that necessary to provide a desired hardening ability in a weight ratio of 4:1 and the vanadium with excess carbon in a weight ratio of 4.2 (V–1):1, said article being characterized by workability, castability, high impact resistance and abrasion resistance.

4. An article made from a ferrous base metal consisting essentially of carbon about 2.7%, silicon about 0.3%, manganese about 0.7%, chromium about 5%, molybdenum about 1%, sulfur up to about 0.25%, titanium about 2.5% and the balance iron with usual impurities in ordinary amounts, said titanium being combined with carbon in excess of that necessary to provide a desired hardening ability in a weight ratio of 4:1 said alloy being characterized by workability, castability, high impact resistance and abrasion resistance.

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