Patented Feb. 14, 1939 2,147,122

UNITED STATES PATENT OFFICE

2,147,122

ALLOY COMPOSITIONS

Joseph V. Emmons, Shaker Heights, Ohio, assignor to The Cleveland Twist Drill Company, Cleveland, Ohio, a corporation of Ohio

No Drawing. Original application August 27, 1934, Serial No. 741,532. Divided and this application August 18, 1938, Serial No. 225,576

9 Claims. (Cl. 75—128)

This application is a division of my co-pending application Serial Number 741,532, filed August 27, 1934.

This invention relates as indicated to alloy compositions and articles made therefrom, and relates more particularly to ferrous alloys of the type in which molybdenum and tungsten are important alloying elements.

In my prior Patent No. 1,937,334, dated November 28, 1933, there are disclosed alloy compositions of the class in which molybdenum and tungsten are principal alloying elements and in which molybdenum and tungsten bear to each other a certain defined proportional relationship. The present invention is, in effect, an extension of the teaching in this prior patent, particularly with respect to variations in the carbon, manganese, silicon, and chromium percentages, as well as the inclusion in such class of compositions of specified amounts of cobalt.

It is among the objects of my invention to provide alloy compositions of the same general character as those disclosed in my above identified prior patent, but which, due to variations in the amounts of certain of the alloying elements used, are better suited for certain purposes than the compositions defined in such prior patent. Other objects of my invention will appear as the description proceeds.

To the accomplishment of the foregoing and related ends, said invention, then, consists of the means hereinafter fully described and particularly pointed out in the claims.

The following description sets forth in detail some approved combinations of ingredients embodying my invention, such disclosed means constituting, however, but a few of the various forms in which the principle of the invention may be used.

My invention may be, as above indicated, stated in general terms as comprising the discovery that certain variations in the composition or compositions disclosed in my aforementioned prior patent result in alloys, particularly useful for certain purposes; more specifically, the present invention relates to variations in the amounts of carbon, manganese, silicon, and chromium and to the use of specified amounts of cobalt.

In accordance with my present invention, an alloy may contain the following elements within the percentages given, viz:—

	Per cent
Carbon	0.30 to 1.60
Manganese	None to 2.00
Silicon	None to 3.00
Chromium	None to 15.00
Tungsten	0.20 to 6.00
Vanadium	None to 5.00
Molybdenum	0.60 to 15.00
Cobalt	1.00 to 16.00

the remainder being substantially iron together with such other alloying ingredients and impurities as are sometimes found in this type of alloy compositions.

A somewhat narrower range of percentages within which the various alloying ingredients may be present in this type of steel is as follows:—

	Per cent
Carbon	0.60 to 0.90
Manganese	0.04 to 1.00
Silicon	0.10 to 0.45
Chromium	2.50 to 10.00
Tungsten	1.00 to 2.50
Vanadium	0.25 to 2.50
Molybdenum	6.00 to 12.00
Cobalt	2.00 to 10.00

the remainder being substantially iron, together with such other alloying ingredients and impurities as are sometimes found in alloying compositions of this type.

Several varieties or specific examples of the "cobalt" type of alloy compositions falling within the above given ranges of percentages for the various ingredients, arranged in the order of their cobalt content, are as follows:

Example	C	Mn	Si	Cr	W	V	Mo	Co
	Per-cent	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*	*Per-cent*
1	0.70	0.40	2.75	3.50	1.50	None	8.00	1.00
2	.72	.08	.34	2.57	1.98	1.01	7.13	2.15
3	.77	.06	.23	2.83	1.94	1.07	6.79	3.97
4	.78	.08	.37	3.58	2.12	2.10	6.29	3.98
5	.40	.30*	1.00	10.00	1.00	0.25	4.00	4.00
6	.70	.30*	1.25	3.25	1.75	1.00	9.25	4.00
7	.60	.30*	2.25	5.25	1.75	1.00	7.00	4.00
8	.74	.07	.37	3.53	1.84	1.00	6.60	4.05
9	.76	.04	.27	3.78	1.77	1.06	6.96	4.07
10	.81	.04	.36	3.78	1.64	1.11	7.54	4.13
11	.80	.03	.49	3.65	1.77	1.08	6.86	5.91
12	.70	.60	.30	1.50	1.50	None	8.00	7.50
13	.75	.30	1.25	None	2.00	1.50	9.00	8.50
14	.73	None	.24	3.50	1.97	.94	11.07	9.34
15	.70	None	.90	3.00	1.50	1.00	8.00	13.00
16	.77	------	------	3.85	1.99	1.03	11.15	9.06

*Denoted below .30%.

the remainder being substantially iron together with such other alloying elements and impurities as are sometimes found in this type of alloy compositions.

Attention is particularly directed to the fact that alloy compositions numbered 1, 5, 6, 7, 13 and 15 in the foregoing table of cobalt-including alloy compositions are also characterized by their high silicon content.

Compositions numbered 1 and 12 are particularly characterized by being "vanadium-free" and composition numbered 13 is characterized by being "chromium-free" as hereinafter defined.

Attention is directed to compositions numbered 9, 10, 11, 14 and 15, which are characterized by being "manganese-free".

The above examples containing cobalt have a range of hardening temperatures from about 2000° F. to about 2300° F. The range of drawing temperatures at which secondary hardness is developed is from about 1000° F. to about 1150° F. Cobalt has been observed to broaden the range of both the hardening and tempering temperatures at which full hardness and strength may be developed.

The cobalt addition also increases somewhat the maximum attainable hardness and appears to slightly increase the resistance of the steel to tempering. Cutting tools such as drills made from many of the above examples have shown a high order of cutting quality, which in some cases has been observed to be greater than that of similar steels containing no cobalt.

The above example numbered 14 has shown excellent physical properties and a high degree of cutting quality when made into drills. This cutting quality was, in fact, better than that of drills made of 18—4—1 high speed steel with which comparisons were made.

The importance of chromium-free alloy compositions is also great as chromium is only obtainable in small quantities in this country. It is believed that alloy compositions such as Example 13, above given, will have a useful field as tool materials, especially so should chromium be difficultly obtainable.

As previously indicated, compositions of the general class disclosed herein are similar to the general class disclosed in my prior Patent No. 1,937,334 with respect to the tungsten and molybdenum content, i. e., the amount of tungsten in the compositions may be broadly stated as comprising about 5% to about 40% of the amount of molybdenum present. A somewhat narrower range of proportional relationships between tungsten and molybdenum contemplates the use of tungsten in amounts from 10% to 30% of the amount of molybdenum present. The broad range of from 5% to 40%, above referred to, may be conveniently divided into the following groups, viz.:—5% to 16%, 16% to 25% and 25% to 40%.

Attention is directed to the fact that certain of the examples included in the foregoing description of my invention may be readily nitrided.

As is well known to those familiar with the art, any specification for a particular alloy composition must permit of certain variations due to the fact that in making up the composition, it is extremely difficult, if not impossible, to commercially produce a composition exactly like a given specification.

It is to be understood, therefore, that throughout the description and claims where I have used figures to denote definite amounts and ranges, such amounts and ranges are to be construed to include the range of variations usually permissible in making up alloy compositions to given specifications.

It should be noted that where the term "none" is used to denote the absence of silicon, manganese, chromium and vanadium, or where an alloy composition is indicated as being "free" from any one or more of these elements, the construction to be placed upon these terms is a commercial absence of the elements in question. Silicon, manganese, chromium and vanadium may be considered as commercially absent if they are present in amounts less than 0.05%.

Other modes of applying the principle of my invention may be employed instead of the one explained, change being made as regards the materials employed, provided the ingredients stated by any of the following claims or the equivalent of such stated ingredients be employed.

I, therefore, particularly point out and distinctly claim as my invention:—

1. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.30 to about 1.60
Molybdenum	About 0.60 to about 15.00
Tungsten	About 0.20 to about 6.00
Cobalt	About 1.00 to about 16.00
Silicon	About 0.05 to about 3.00
Manganese	About 0.04 to about 2.00
Vanadium	About 0.05 to about 5.00
Chromium	About 0.05 to about 15.00

the remainder being substantially all iron, the amount of tungsten present being from about 5% to about 40% of the amount of molybdenum present.

2. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.60 to about 0.90
Molybdenum	About 6.00 to about 12.00
Tungsten	About 1.00 to about 2.50
Cobalt	About 2.00 to about 10.00
Silicon	About 0.10 to about 0.45
Manganese	About 0.04 to about 1.00
Vanadium	About 0.25 to about 2.50
Chromium	About 2.50 to about 10.00

the remainder being substantially all iron, the amount of tungsten present being from about 5% to about 40% of the amount of molybdenum present.

3. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.30 to about 1.60
Molybdenum	About 0.60 to about 15.00
Tungsten	About 0.20 to about 4.50
Cobalt	About 1.00 to about 16.00
Silicon	About 0.05 to about 3.00
Manganese	About 0.05 to about 2.00
Vanadium	About 0.05 to about 5.00
Chromium	About 0.05 to about 15.00

the remainder being substantially all iron, the amount of tungsten present being from about 10% to about 30% of the amount of molybdenum present.

4. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.30 to about 1.60
Molybdenum	About 0.60 to about 15.00
Tungsten	About 0.20 to about 2.40
Cobalt	About 1.00 to about 16.00
Silicon	About 0.05 to about 3.00
Manganese	About 0.05 to about 2.00
Vanadium	About 0.05 to about 5.00
Chromium	About 0.05 to about 15.00

the remainder being substantially all iron, the amount of tungsten present being from about 5% to about 16% of the amount of molybdenum present.

5. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.30 to about 1.60
Molybdenum	About 0.60 to about 15.00
Tungsten	About 0.20 to about 3.75
Cobalt	About 1.00 to about 16.00
Silicon	About 0.05 to about 3.00
Manganese	About 0.05 to about 2.00
Vanadium	About 0.05 to about 5.00
Chromium	About 0.05 to about 15.00

the remainder being substantially all iron, the

amount of tungsten present being from about 16% to about 25% of the amount of molybdenum present.

6. A ferrous alloy composition comprising:

	Per cent
Carbon	About 0.30 to about 1.60
Molybdenum	About 0.60 to about 15.00
Tungsten	About 0.20 to about 6.00
Cobalt	About 1.00 to about 16.00
Silicon	About 0.05 to about 3.00
Manganese	About 0.05 to about 2.00
Vanadium	About 0.05 to about 5.00
Chromium	About 0.05 to about 15.00

the remainder being substantially all iron, the amount of tungsten present being from about 25% to about 40% of the amount of molybdenum present.

7. A ferrous alloy composition consisting of:

	Per cent
Carbon	About 0.72
Manganese	About .08
Silicon	About .34
Chromium	About 2.57
Tungsten	About 1.98
Vanadium	About 1.01
Molybdenum	About 7.13
Cobalt	About 2.15

and the remainder being substantially all iron.

8. A ferrous alloy composition consisting of:

	Per cent
Carbon	About .78
Manganese	About .08
Silicon	About .37
Chromium	About 3.58
Tungsten	About 2.12
Vanadium	About 2.10
Molybdenum	About 6.29
Cobalt	About 3.98

and the remainder being substantially all iron.

9. A ferrous alloy composition consisting of:

	Per cent
Carbon	About 0.81
Manganese	About .04
Silicon	About .36
Chromium	About 3.78
Tungsten	About 1.64
Vanadium	About 1.11
Molybdenum	About 7.54
Cobalt	About 4.13

and the remainder being substantially all iron.

JOSEPH V. EMMONS.