

UNITED STATES PATENT OFFICE.

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ALLOY.

1,333,151.

Specification of Letters Patent.

Patented Mar. 9, 1920.

No Drawing.

Application filed September 26, 1919. Serial No. 326,504.

To all whom it may concern:

Be it known that I, FREDERICK M. BECKET, a citizen of the United States, residing at Niagara Falls, in the county of Niagara and State of New York, have invented certain new and useful Improvements in Alloys, of which the following is a specification.

This invention relates to a novel alloy containing as essential components chromium, manganese and iron, proportioned to impart to the alloy certain distinctive properties, among which are a high degree of resistance to oxidation in combination with a relatively low magnetic permeability. This combination of properties in a machinable and forgeable alloy renders the product useful for a wide variety of purposes, including such special applications as electrode heads for electric furnaces, and other furnace parts which are so located with relation to the electric circuit that a material of high magnetic permeability would lower the power factor of the furnace.

The desirable and distinctive properties of the alloy have been found to exist throughout a rather wide range of proportions of the principal components, but in general my invention contemplates an alloy comprising:

Chromium-----	10-45 per cent.
Manganese-----	3-25 " "
Carbon-----	0-3 " "
Silicon-----	0-3 " "

the balance being principally iron, and the chromium predominating over the manganese.

While serviceable alloys may be made throughout the range specified above, I prefer for most purposes an alloy wherein the chromium content is between 15 and 35 per cent., the percentage of manganese being always less than that of the chromium and being comprised between the limits of 5 and 15 per cent. In this preferred embodiment of the invention carbon is present to the extent of 0.1 to 2.0 per cent. and silicon within the same limits.

The specific composition of the alloy will of course be varied according to the particular characteristics and properties desired, and in accordance with its intended use. Throughout the range specified the alloy possesses the following properties:

(1) A high degree of resistance to oxidation even at very high temperatures. In general the alloys may be heated in air to 1000-1100° C. or higher without destructive effects. For example, samples exposed to air at a temperature of 1050° C. for 120 hours have shown oxidation losses of the order of 1.0-3.0%, after mechanically removing the scale. Under identical conditions test samples of cast iron and steel showed losses of the order of 80-95 per cent. With the same chromium content, the oxidizability at high temperatures tends to increase somewhat with increasing manganese content, but this tendency may be counteracted to a large extent at least by increasing the chromium content, which should therefore exceed the manganese content.

(2) A low magnetic permeability as compared with that of cast iron or steel. In general the permeability tends to decrease with increasing percentages of manganese or of carbon, or of manganese and carbon. Permeability not exceeding 2-5 per cent. of that of cast iron is readily attained.

(3) A high tensile and transverse strength relative to cast iron. As a rule the tensile strength of the cast alloy is upward of 20,000 lbs. per square inch, and usually of the order of 40,000-45,000 lbs. or higher. The transverse strength is in general from 1½ to 2 times that of cast iron.

(4) The alloys are highly responsive to heat treatment as compared with cast iron. For example by heating the cast alloy to 1000-1100° C. for several hours (depending upon the size of the piece) and then cooling in the furnace, its tensile strength may be increased 50-80 per cent. The forged alloys are likewise responsive to similar heat treatment, and in this way alloy articles having a tensile strength in excess of 100,000 lbs. per square inch have been made.

(5) The alloys are machinable and forgeable, these qualities being somewhat more pronounced in the alloys having the lower content of manganese and of carbon. With very high chromium content the alloys are less readily forgeable, but are machinable.

The alloys may be prepared in various ways. For example high grade ferro-manganese or manganese metal may be added to ferrochromium in the required proportions, with or without the addition of iron in the

- form of steel scrap or otherwise, the charge being melted and mixed in electrically heated crucibles. They may likewise be prepared by direct smelting in an electric furnace of a charge containing ores of chromium and of manganese, with or without scrap steel or other form of iron. In such operations silicon or ferrosilicon is preferably employed as the reducing agent.
- 10 Relatively small proportions of other elements, including tungsten, zirconium, vanadium, titanium, nickel, aluminum, etc., may be introduced into the alloy without departing from my invention.
- 15 Analyses of representative alloys in accordance with my invention have shown:

	(1)	(2)	(3)
20 Chromium.....	30.21	24.60	23.08
Manganese.....	4.30	10.24	19.00
Carbon.....	1.23	1.08	1.20
Silicon.....	0.18	0.95	0.49
Iron.....	63.63	62.37	56.10
	99.55	99.24	99.87

- 25 Of the above typical examples, the magnetic permeability of (1) was of the order of $\frac{1}{4}$ to $\frac{1}{3}$ that of cast iron. That of (2) and (3) was about 2-5% of that of cast iron.

I claim:

1. A machinable alloy characterized by its resistance to oxidation at high temperatures, its low magnetic permeability relative to steel and cast iron, and by its responsiveness to heat treatment, said alloy comprising:

Chromium.....	10-45%
Manganese.....	3-25%
Carbon.....	0- 3%
Silicon.....	0- 3%

the balance being principally iron.

2. A machinable alloy characterized by its resistance to oxidation at high temperatures, its low magnetic permeability relative to steel and cast iron, and by its responsiveness to heat treatment, said alloy comprising:

Chromium.....	15-35%
Manganese.....	5-15%
Carbon.....	0.1- 2%
Silicon.....	0.1- 2%

the balance being principally iron.

In testimony whereof I affix my signature.

FREDERICK MARK BECKET.