UNITED STATES PATENT OFFICE.

JAMES CHURCHWARD, OF NEW YORK, N. Y.

ALLOY STEEL.

No. 867,642. Specification of Letters Patent. Patented Oct. 8, 1907.

Application filed March 5, 1907. Serial No. 360,744.

To all whom it may concern:

Be it known that I, JAMES CHURCHWARD, a subject of the King of Great Britain, residing in the borough of Manhattan, in the city, county, and State of New York, have invented certain new and useful Improvements in Alloyed Steels, of which the following is a specification.

The present invention relates to alloys of steel, where titanium and chromium are employed as two of the alloying metals, and the object of the invention is to produce a particularly hard and tough metal with a high tensile strength, which will be suitable for many purposes and cases.

In carrying out the present invention there is mixed with commercially pure iron or steel relatively small proportions of titanium, chromium, manganese and nickel. The alloy is melted either by open hearth or crucible methods, and cast in any form required either in ingots to be reduced to required forms or in any particular form required.

A suitable proportion of the several metals for producing a hard and tough steel will be understood from the following formula, in which the proportions are designated in percentages by weight, namely:—

Steel, (containing 0.50 per cent. carbon)....	96.00%
Titanium,.....	1.00%
Chromium,.....	.50%
Nickel,.....	2.00%
Manganese,.....	.50%
	100.00%

The carbon may be added to the iron or steel in many known ways and it may vary from .15% to 1.00% according to the use to which the alloy is to be applied. The percentages of the alloying metals may also be varied for the same reason and come within the broad scope of my invention. For example, these metals may vary in proportion by weight as follows:—

Iron or steel,	from	about	98.20	to	about	74.00	pts.
Titanium,...	"	"	.50	"	"	10.00	"
Chromium,..	"	"	.15	"	"	5.00	"
Nickel,.....	"	"	1.00	"	"	10.00	"
Manganese,..	"	"	.15	"	"	1.00	"
			100.00 parts.			100.00 parts.	

Ferro compounds of the several alloying metals may be used in lieu of the pure metals.

Titanium has a much higher melting point than any of the other elements named in the list above, its melting point, being believed to be about 3000° C.; and under ordinary conditions, if molten titanium were mixed with the molten steel direct, or with the alloy of nickel and steel, the great difference between the melting points would cause the titanium to chill and segregate; but with a small percentage of manganese added, this difficulty is overcome if the procedure be the proper one. With the proper employment of manganese, the titanium will be completely assimilated so that a conglomerate particle is formed in which no microscopic segregation of titanium is visible. In this formation of nickel-titanium-chrome-steel the employment of manganese is absolutely essential to prevent the chilling of the molten titanium when the steel comes in contact with it. The action of the manganese is both chemical and physical in its character, for on the titanium coming in contact with it, a new and independent action which may be characterized as artificial boiling, is set up in the molten mass, and this prevents the chilling and segregating of the titanium, in the same manner that open water is prevented from freezing in very cold weather by agitation or stirring. During the action caused by the presence of manganese, which forms an interchange between the particles of iron and those of titanium, the chilling action of the less refractory metals on the more refractory metal is eliminated for the time, and then, before the chilling action is begun, the titanium will have been absorbed and assimilated by the particles of the iron. By assimilation I mean the entry of the alloying metal into intimate union with the stock steel.

Without the intermediation in the alloy of the metal manganese, the titanium would not become a part of the mass-particle, but would form minute segregations between the particles, thereby adding nothing valuable to the characteristics or physical properties of the alloy.

The procedure for making the alloy is as follows: The titanium is melted in a crucible at a temperature believed to be about 3000° C., and the steel, nickel and chromium are melted in another crucible and heated up to a point just below the point of volatilization of that metal having the lowest volatilizing point. The manganese is now added to the molten titanium, and while it is being melted and incorporated with the latter the molten nickel-chromium-steel alloy from the other crucible is, preferably, added by pouring it in the crucible containing the titanium and from which the alloy formed may be poured or cast directly into the mold.

The nickel is employed to impart toughness to the alloy. The chromium is employed to impart hardness and the titanium is employed to increase both hardness and toughness. Obviously the titanium may be melted at the same time the nickel and steel are being melted; and the only object in pouring the nickel-chromium-steel into the crucible containing the titanium, instead of the reverse, is that the titanium has the lower specific gravity.

The producing of alloyed steels by pouring molten

metals from one crucible to another, is not new and is not herein claimed.

Having thus described my invention, I claim—

1. An alloyed steel containing parts or percentages of titanium, chromium, nickel and manganese.

2. An alloyed steel containing the following metals in about the proportions given, namely: steel, which contains from .15% to 1.% of carbon, 98.20 to 74 parts; titanium .50 to 10 parts; chromium .15 to 5 parts; nickel 1 to 10 parts and manganese .15 to 1 part.

3. An alloyed steel containing the following metals in about the proportions given, namely:—steel having in it .50% of carbon, 96 parts; titanium 1 part; chromium .50 parts; nickel 2 parts and manganese .50 parts.

In witness whereof I have hereunto signed my name this 4th day of March 1907, in the presence of two subscribing witnesses.

JAMES CHURCHWARD.

Witnesses:
H. G. HOSE,
WILLIAM J. FIRTH.