

UNITED STATES PATENT OFFICE.

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ALLOY.

No Drawing. Application filed December 9, 1920. Serial No. 429,544.

To all whom it may concern:

Be it known that I, PIERRE GIRIN, a citizen of the Republic of France, residing at 84 Rue de Lille, Paris, Seine, France, have invented new and useful Improvements in Alloys, which is fully set forth in the following specification.

This invention has for object improvements in the alloy resisting oxidation which is described in my application filed Dec. 9, 1918, Ser. No. 265,985, primarily with a view of adapting the alloy to the particular conditions which are necessitated by manufacture on a large scale in a metallurgical apparatus such as the Martin furnace. To this end the limiting content of carbon and manganese originally prescribed has been extended and according to this invention the carbon may be carried to 1 per cent, and the manganese to 5 per cent.

Moreover, it has now been found, as the result of new experiments, that the alloy retains its specific properties when the limiting content of nickel and chromium is more extended than that prescribed in the said application. For the nickel the proportions fixed in the said application were 60 to 70 per cent; by the present invention they may be 50 to 80 per cent; for the chromium, instead of 10 to 15 per cent, the proportions may be 8 to 25 per cent. So also, the proportions of tungsten and molybdenum may be lowered respectively to 0.5 per cent and 0.2 per cent so as to increase notably the capacity for being forged, without which the alloy ceases to possess the properties indicated.

It has further been found that these alloys have a certain number of industrial applications, whether made as described in the said application or as described herein; these have not been mentioned in the said application.

The alloy which is the basis of the present invention contains essentially iron, a high content of nickel, chromium, tungsten, manganese. It may include as accessories molybdenum, cobalt, vanadium and titanium. It is easy to make in large quantities and is adapted to be cast, forged, rolled,

drawn and worked. The typical alloy comprises:

	Per cent.	
Nickel	50 to 80	
Chromium	8 to 25	55
Tungsten	0.5 to 8	
Manganese	1 to 5	
Carbon	0.3 to 1	
Iron	The rest	60

Example of composition: Ni: 65, Cr: 12, W: 1.5, Mn: 3, C: 0.5, iron: the rest.

The maximum content for manganese and minimum and maximum for nickel and chromium are carried respectively to 5 per cent, 50 per cent, and 80 per cent, and 8 per cent, and 25 per cent, in order to agree with the necessities of working, the yields and the nature of the added materials used in the Martin furnace. The presence of the manganese is essential to ensure perfect homogeneity of the metal as well as a satisfactory capacity for forging.

There are certain modifications of composition possible without bringing about important modifications of quality; thus for 0.5 to 8 per cent of tungsten may be substituted 0.2 to 5 per cent of molybdenum, or these two metals may be added together, say to the extent of 0.2 to 8 per cent, of the total.

This extension of content in tungsten and molybdenum over that indicated in the aforesaid application is owing to the experience that these metals are efficient even in small proportion for imparting resistance to corrosion.

The properties may be further improved, while facilitating the manufacture, by adding to the alloy above defined 0.2 to 1 per cent of vanadium, or 0.1 to 0.2 per cent of titanium, or 0.1 to 1 per cent of a mixture of vanadium and titanium. So also 0 to 10 per cent of cobalt may be added with a view of improving the mechanical strength of the alloy. The proportions of the added elements indicated are added at the cost of the content of iron.

The alloy in which the various elements have a mean value, such as the example indicated above, may have a tensile strength

of 25 to 35 kilos per square mm. with an elastic limit of 20 to 30 kilos and a coefficient of elongation of 40 per cent at a temperature of 800° C., the values indicated in the aforesaid application, while being totally devoid of brittleness. When the content of tungsten or molybdenum or their mixture falls to the neighbourhood of the lower limit indicated, the facility with which the alloy can be forged is notably increased, in the sense that this operation may be performed, with less precaution and within the limits of temperature more extended; on the contrary, the figures indicated for the tensile strength and the elastic limit at 800° C., while being incomparably higher than those of all steels or special alloys, are susceptible to a diminution of 5 to 10 kilos per square mm. respectively without sensibly modifying the coefficient of elongation.

The following are industrial applications of the alloys forming the subject matter of the aforesaid application and of this invention:

Manufacture of apparatus used in chemical industry for synthetic reactions; in particular those used for the synthesis of ammonia (notably when these apparatus

have to resist besides corrosion by gases, high temperatures and pressures).

Manufacture of all parts of heat engines operating at high temperatures, such as valves, distributors, combustion chambers or pressure generators.

Manufacture of all engines which must support high static or dynamic forces and also a high temperature and action of chemical agents, such as receivers of autoclaves for synthesis, for chemical reactions, or recuperation of heat, burner nozzles, injector nozzles operating in a superheated surrounding, or diffusing gases and vapours or liquids of corrosive kind.

Having thus described the nature of the said invention and the best means I know of carrying the same into practical effect, I claim:—

1. That alloy of iron, chromium, nickel, tungsten and manganese comprising nickel 50 to 80 percent, chromium 8 to 25 percent, tungsten 0.5 to 8 percent, manganese 1 to 5 percent, and carbon 0.3 to 1 percent.

2. An alloy as set forth in claim 1 comprising also from 1 to 10 percent of cobalt.

In testimony whereof I have signed this specification.

PIERRE GIRIN.