Patented Dec. 18, 1934 1,984,458

UNITED STATES PATENT OFFICE

1,984,458

CAST IRON ALLOY ARTICLES

Charles O. Burgess, New York, N. Y., assignor to Electro Metallurgical Company, a corporation of West Virginia

No Drawing. Application July 28, 1933, Serial No. 682,631

2 Claims. (Cl. 148—21.7)

When ordinary grey cast iron is slowly cooled, graphite separates from the ground mass in the form of relatively large flakes which tend to weaken the casting. The formation of graphite flakes may be decreased or entirely eliminated by keeping the silicon or nickel low, or by raising the manganese content, or by chill-casting the metal, or by a combination of these or other expedients, whereby there is produced a mottled or white casting. However, mottled or white cast iron so produced is brittle, hard, and unmachinable, and must be malleableized or annealed. The malleableizing or annealing treatment renders the casting malleable and machinable.

It is an object of the invention to provide a method of making annealed iron castings having improved hardness and strength.

This and other objects are attained by alloying cast iron with a carbide stabilizing element and subsequently annealing the casting so treated. This is in direct conflict with the usual idea prevalent in malleable foundries that the accidental presence of carbide forming elements results in an inferior iron. On the contrary, in the present invention it has been found possible by proper control of the analysis and annealing temperature satisfactorily to anneal or partly malleableize a cast iron containing an appreciable amount of a carbide forming element such as chromium and that such an iron will possess satisfactory ductility, high wear resistance and much greater strength than ordinary malleable iron.

Suitable carbide forming elements according to the invention include chromium, tungsten, and vanadium. The cast iron composition and casting procedure are chosen to give in known manner a white or mottled iron, and the casting is then annealed. The resultant product is ductile and workable, yet has a strong, heat resistant, wear resistant pearlitic or partly pearlitic ground mass structure. The improved strength of the ground mass probably results in part from the retention of the pearlitic structure, and in part from the strengthening and hardening effect of the carbide forming element dissolved in the ferrite. The carbon is distributed as graphite and carbides of the carbide forming elements, and the distribution and form of the carbon is such that it does not tend materially to weaken the casting. At least a major part of the graphite is in the form of temper carbon.

The composition of the cast iron to which the carbide forming element is added may suitably be substantially 1.5% to 4% carbon, 0.5% to 3.5% silicon and/or nickel, manganese 0.15% to 0.7%, phosphorus 0.05% to 1.5%, sulfur up to about 0.5%, and the remainder iron. A preferred composition comprises substantially 2% to 3% carbon, 0.6% to 2.5% silicon, 0.15% to 0.7% manganese, 0.05% to 0.2% phosphorus up to 0.1% sulfur, and the remainder iron.

The amount of carbide forming element to be added for the best results is governed to some extent by the percentage of total carbon and silicon in the cast iron, and by the casting conditions. Sufficient carbide forming element should be present so that a strong pearlitic ground mass is retained after annealing. In general, 0.10% to 5% of the carbide forming element will be sufficient, and a preferred range under most circumstances is 0.10% to 0.75%.

The preferred range of annealing temperatures is between about 900° F. and about 1900° F., the most favorable annealing temperature, in general, being governed by the content of the carbide forming element, and being higher with an increased content of the carbide forming element. The annealing treatment may comprise a single long treatment at an annealing temperature, or a series of short treatments alternately at 1700° F. to 1900° F. and at 900° F. to 1500° F. The annealed casting should be cooled very slowly from the annealing temperature to room temperature.

The presence of elements other than those specifically mentioned herein is not precluded, and may under some circumstances be desirable.

I claim:

1. A strong, wear resistant, cast article consisting in its metallographic structure substantially of pearlite, chrome-ferrite, flake graphite, and temper carbon, and containing about 1.5% to 4% carbon, 0.5% to 3.5% silicon, 0.15% to 0.7% manganese, 0.05% to 0.3% phosphorus, up to about 0.5% sulfur, 0.10% to 5% of a carbide forming element of the group consisting of chromium, tungsten, and vanadium, the remainder iron; which article has been annealed at temperatures between about 900° F. and about 1900° F., and thereafter slowly cooled.

2. Method of producing strong, wear resistant, cast articles which comprises adding about 0.10% to about 5% of a carbide stabilizing element of the group consisting of chromium, tungsten, and vanadium, to a molten composition consisting substantially of 1.5% to 4% carbon, 0.5% to 3.5% silicon, 0.15% to 0.7% manganese, 0.05% to 0.3% phosphorus, up to about 0.5% sulfur, remainder iron; casting the mixture to give a mottled casting; annealing the casting at temperatures between about 900° F. and about 1900° F., and thereafter slowly cooling the casting.

CHARLES O. BURGESS.