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FERROUS MATERIAL

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ABSTRACT OF THE DISCLOSURE

The disclosure pertains to a ferrous material consisting essentially of from 1.5% to 4.0% carbon; from 3.3% to 6.0% silicon; from 0.0015% to 0.1% boron; from 0.2% to 5.0% manganese; 0.2% maximum sulphur; 0.6% maximum phosphorus; not more than 0.2% aluminum; not more than 0.2% bismuth; not more than 0.2% titanium and 2.0% maximum chromium, together with iron, the material having a microstructure in which the hypereutectoid carbon consists of free carbides and graphite in nodular form.

This invention has as its object the provision of an improved ferrous material which combines a high modulus of elasticity with a high tensile strength whilst at the same time having good bearing and wearing properties.

In accordance with the invention, there is provided a ferrous material consisting essentially of from 1.5% to 4.0% carbon; from 3.3% to 6.0% silicon; from 0.0015% to 0.1% boron; from 0.2% to 5.0% manganese; 0.2% maximum sulphur; 0.6% maximum phosphorus; not more than 0.2% aluminium; not more than 0.2% bismuth; not more than 0.2% titanium and 2.0% maximum chromium, together with iron, the material having a microstructure in which the hypereutectoid carbon consists of free carbides and graphite in nodular form.

Conveniently, the boron and the bismuth (where used) and the aluminium (where used) are added when the material is molten, e.g. at a temperature of 1,610° C., or thereabouts. Heat treatment of the material may be carried out in order to reduce the free (hyperecutectoid) carbides in quantity and to spheroidise them in form, or to vary the structure of the matrix (e.g., to pearlite, bainite, martensite) as may be required.

Further, other alloying elements such as nickel, molybdenum, vanadium and copper may be added to vary the structure and properties of the material.

In carrying the invention into effect a ferrous material is prepared having a composition which falls within the definition set out above, that is to say the material contains from 1.5% to 4.0% carbon; from 3.3% to 6.0% silicon; from 0.0015%–0.1% boron; from 0.2%–5.0% manganese; 0.2% maximum sulphur; 0.6% maximum phosphorus; not more than 0.2% aluminium; not more than 0.2% bismuth; not more than 0.2% titanium and 2.0% maximum chromium, together with iron. As a more specific example, the material may consist of 1.7%–1.9% carbon; 3.4%–4.0% silicon; 0.005%–0.018% boron;

0.4%–0.7% manganese; 0.08% maximum sulphur; 0.08% maximum phosphorus; 0.08% aluminium; 0.08% maximum titanium; 1.1%–1.3% chromium and 0.2%–0.6% molybdenum. The boron and aluminium are added whilst the material is molten (e.g., at 1,610° C.) and the material is then cast prior to heat treatment in order to produce a microstructure having the desired form. For example, the heat treatment may consist of holding the cast material at 950° C. for one hour, cooling in a furnace to 600° C. and then cooling in air. This will produce a pearlitic matrix, a substantial amount of hypereutectoid carbon (i.e. free carbides) with graphite in nodular form. The heat treatment can however, be varied so as to produce a bainitic matrix, or a martensitic matrix as may be required. Nevertheless, in all cases, the hypereutectoid carbon will be present with the graphite carbon in nodular form. This results in high elasticity and tensile strength in addition to good bearing and wearing properties so that material formed in accordance with the present invention is found to be particularly suitable for use, inter alia, in the manufacture of centrifugally cast piston rings for internal combustion engines. Material formed in accordance with the invention, can, however, be used for purposes other than the manufacture of piston rings.

Having thus described my invention what I claim as new and desire to secure by Letters Patent is:

1. A ferrous material consisting essentially of from 1.5% to 4.0% carbon; from 3.3% to 6.0% silicon; from 0.0015% to 0.1% boron; from 0.2% to 5.0% manganese; 0.2% maximum sulphur; 0.6% maximum phosphorus; not more than 0.2% aluminium; not more than 0.2% bismuth; not more than 0.2% titanium and 2.0% maximum chromium, together with iron, the material having a microstructure in which the hypereutectoid carbon consists of free carbides and graphite in nodular form.

2. A ferrous material as claimed in claim 1 consisting essentially of from 1.7% to 1.9% carbon; from 3.4% to 4.0% silicon; from 0.005% to 0.018% boron; from 0.4% to 0.7% manganese; 0.08% maximum sulphur; 0.08% maximum phosphorus; 0.08% aluminium; 0.08% maximum titanium; from 1.1% to 1.3% chromium and 0.2% to 0.6% molybdenum together with iron.

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