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(54) Bainitic steels.

(57) Tough, wear-resistant steels suitable for railway, tramway and travelling crane applications.

Said steels contain manganese 0,3 to 3,0%, molybdenum 0,2 to 3,0% and boron up to 0,01%, balance iron and incidental impurities; they may optionally contain nickel and/or chromium and/or copper to up to 6% for each of these elements.

The steel has a bainitic structure and the austenite-to-bainite transformation temperature is below 550 °C; it is easily weldable.

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ALLOY STEELS

This invention relates to alloy steels, and is particularly though not necessarily exclusively concerned with alloy steels for railway, tramway and travelling crane applications.

It has long been recognised that such items as railway or the like points and crossings should be produced from a tough wear resistant alloy steel, and accordingly such railway or the like points and crossings are predominantly formed as castings from austenitic manganese steel. Whilst austenitic manganese steel is eminently suited for use with such points and crossings, it has the major disadvantage that it is impractical to weld such steels directly to those steels, normally used in the production of railway and the like rails and from which railway and the like lines themselves are produced.

In an attempt to overcome this problem it has been proposed hitherto to provide a short transitional piece for location between points or crossings and the associated rails, of a nature that is capable of welding to both austenitic manganese steel and those steels normally used in the production of rails. Whilst such proposals might be successful, they introduce the

disadvantages of cost firstly because of the need to produce such transitional pieces and secondly because of the increase in the number of welds required.

In addition, and in the field of railway, tramway and travelling crane applications, it is well-known for the wheels of railway engines and rolling stock, tramcars, and travelling cranes, to be formed from steel, with the wheel, or at least a rim portion on the wheel, formed from a tough, wear-resistant steel, but which at the same time must be capable of allowing relatively conventional forming techniques, such as forging and rolling, casting or compaction and fusion of particulate feedstock, to be employed.

The object of the present invention is to provide an alloy steel capable of use in both cast and wrought forms that is both tough and wear resistant and hence capable of use in e.g. railway, tramway and travelling crane applications, such as in the production of, e.g., railway and the like points and crossings and is at the same time able to be welded direct to those steels normally used in the production of railway and the like rails, and in the production of wheels or rims for wheels.

According to the present invention alloy

steel comprises boron present and up to 0.01 weight percent, molybdenum 0.2 to 3.0 weight percent, manganese 0.3 to 3.0 weight percent, balance iron and incidental impurities, said alloy steel being a bainitic steel and having an austenite-to-bainite transformation temperature below 550°C. Preferably nickel is present in the amount up to 6 weight percent, chromium is present in the amount up to 6 weight percent and copper is present in the amount up to 6 weight percent.

Thus, the alloy steel of the invention is a bainitic steel which preferably has a bainitic transformation temperature in the range 440°C to 470°C and still more preferably 460°C.

In its basic form, the alloy steel of the invention is both wear and impact resistant and effectively combines the properties of toughness, ductility and fatigue resistance, and is therefore ideal as an alloy steel for use in the production of either cast or wrought railway points and crossings. More importantly such a bainitic steel is able to be welded not only to itself but direct to those steels, normally used in the production of railway and the like rails, and as its costs of production are not noticeably different from those in the production of austenitic manganese steel.

In its application to railway or the like systems, the invention may afford reduced total costs by avoiding the need for the separate production of a transition piece and by reducing the number of welding operations required to produce a railway or the like line system.

A preferred alloy steel composition in accordance with the invention is as follows (weight percent), carbon 0.08, silicon 0.3, manganese 0.7, sulphur 0.01, phosphorous 0.01, molybdenum 0.5, boron 0.002, chromium 2.0, nickel 3.0, balance iron and incidental impurities. In addition, copper in the amount up to 2.00 weight percent may be included. The presence of molybdenum and boron at the levels given provides a bainitic steel capable of being hardened over a wide range of cooling rates, and by maintaining carbon at very low levels, there is provided improved weldability by reducing any tendency for the formation of brittle martensite.

The inclusion of nickel in such steels improves noticeably its impact properties, and the inclusion of chromium is of considerable assistance in improving weldability by its depression of the bainitic transformation temperature to an extent greater than its suppression of the martensite

temperature which results in the maintenance of a martensite temperature sufficiently high to avoid the production of brittle martensite during welding. Whilst manganese is an essential element, it should be kept low to assist weldability. Additions of copper increases the hardness and strength in the normalised condition and these properties can be further improved by additional heat treatment.

In addition to its use in the production of points and crossings, the material of the invention is well suited to the production of wheels or the rims for wheels for railway engines and rolling stock, tramcars and travelling cranes, by providing those required properties of toughness and wear resistance, and allowing relatively conventional forming techniques to be employed.

Thus, a wheel is formed by a rim portion with one or two flanges, with the rim portion attached to or integral with a thinner web or plate section. Centrally of the web or plate section is a boss or hub, which can be integral with the web or separate therefrom and suitable secured to the web or plate section, with the boss or hub machined or punched to provide a through-bore through which an axle can be inserted. In accordance with the

invention, either the rim alone, or the whole of the wheel is formed from the alloy steel as hereinbefore defined, by forging and/or rolling, by casting, or by compaction and fusion of particulate feedstock.

Preferably, such rims or wheels are heat treated by heating to above transformation temperature, with subsequent controlled cooling in air, oil, water or other suitable medium, and can be further heat treated by heating to a temperature below the transformation temperature and controlled cooling in air, oil, water or other suitable medium.

CLAIMS

1. An alloy steel comprising boron present and up to 0.01 weight percent, molybdenum 0.2 to 3.0 weight percent, manganese 0.3 to 3.0 weight percent, balance iron and incidental impurities, said alloy steel being a bainitic steel and having an austenite-to-bainite transformation temperature below 550°C.

2. An alloy steel as in Claim 1, wherein nickel is present in the amount up to 6 weight percent.

3. An alloy steel as in Claim 1 or Claim 2, wherein chromium is present in the amount up to 6 weight percent.

4. An alloy steel as in any one of Claims 1 to 3, wherein copper is present in the amount up to 6 weight percent.

5. An alloy steel as in any one of Claims 1 to 4, wherein the bainitic steel has a bainitic transformation temperature in the range 440°C to 470°C.

6. An alloy steel as in Claim 5, wherein the bainitic steel has a bainitic transformation temperature of 460°C.

7. An alloy steel as in any of Claims 1 to 6, wherein it comprises (weight percent) carbon

0.08, silicon 0.3, manganese 0.7, sulphur 0.01, phosphorous 0.01, molybdenum 0.5, boron 0.002, chromium 2.0, nickel 3.0.

8. An alloy steel as in Claim 7, wherein copper is present in the amount 2.00 weight percent.

9. Railway, tramway and travelling crane line points and crossings when formed from the alloy steel of any one of Claims 1 to 8.

10. Railway, tramway and travelling crane wheels and/or wheel rims when formed from the alloy of any one of Claims 1 to 8.

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EUROPEAN SEARCH REPORT

Application number

EP 84 30 5111

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
X	US-A-3 303 061 (WILSON) * claims 1,2; column 1, lines 58-62 *	1,4,7,8	C 22 C 38/12 C 22 C 38/04 E 01 B 7/00
X	US-A-2 513 395 (BARDGETT) * claims 1-3; column 3, table 2, example 1 *	1	
X	GB-A-1 020 913 (YAWATA IRON & STEEL CY.) * claim 1 *	1,3	
X	FR-A-2 211 531 (BETHLEHEM STEEL CORP.) * claims 1,8; page 4, lines 34-36; page 5, lines 2-17 *	1,3	
X	US-A-2 798 805 (HODGE et al.) * claims 1,2 *	1-3,10	TECHNICAL FIELDS SEARCHED (Int. Cl.4) C 22 C 38 E 01 B
X	US-A-3 288 600 (JOHNSEN et al.) * claims 1,3,4 *	1,3,4	
A	FR-A-2 200 847 (UGINE ACIERS) * claims 1,4 *	1-3	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	05-11-1984	LIPPENS M.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

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