(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 163 331 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
17.03.2010 Bulletin 2010/11

(51) Int Cl.:
B22F 9/08 *(2006.01)*

(21) Application number: **08153706.0**

(22) Date of filing: **19.07.1999**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE

(30) Priority: **06.08.1998 SE 9802682**

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
99935265.1 / 1 742 753

(27) Previously filed application:
19.07.1999 PCT/SE99/01293

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Remarks:
This application was filed on 31-03-2008 as a divisional application to the application mentioned under INID code 62.

(54) **Alloyed, non-oxidising metal powder**

(57) Powder mixture comprising a powder produced from oxidation sensitive metal and an atomised, alloyed, non-oxidising metal powder based on iron enriched with carbide-bound carbon in the surface layer that has been carbide-bound to the metals by carbonized atomized medium selected from the group comprising paraffin, diesel oils, or other cyclic or acyclic hydrocarbons. The powder particles of said non-oxidising metal powder comprise one or more of the alloying substances chromium, manganese or silicon.

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Description

[0001] The present invention relates to an atomised, non-oxidising, alloyed metal powder based on iron enriched with carbide-bound carbon in the surface layer, and also to the use of the atomised, non-oxidising, alloyed metal powder.

[0002] Most metal powders are produced by means of atomising, electrolysis or through chemical or oxide reduction. Powder is used in mixtures for producing alloy compositions that are bound metallurgically upon sintering. Metallic and non-metallic powders can be combined to produce composite material having special properties.

[0003] The powder metallurgical composition most frequently used is iron powder, which is used in the manufacture of various structured parts. Iron powder is sometimes used alone or, which is more usual, together with various additives in order to improve the mechanical properties of compacted sintered products. Powder additives include carbon, copper, nickel and molybdenum.

[0004] US, A, 5,522,914 reveals an alloyed metal powder composed of 0.80 to 3.00 per cent by weight carbon, 0.20 to 2.00 per cent by weight manganese, 0.20 to 1.50 per cent by weight silicon, as well as 3.0 to 12.0 per cent by weight chromium, 0.20 to 0.30 per cent by weight sulphur, up to 0.04 per cent by weight phosphorous, 0.25 to 10.0 per cent by weight vanadium, up to 11.0 per cent by weight molybdenum, up to 18.00 per cent by weight mercury, up to 10 per cent by weight cobalt and up to 0.10 per cent by weight nitrogen, besides the iron. The oxygen content in the powder is less than 0.025 per cent by weight. The powder is produced by atomisation in nitrogen gas atmosphere in order to achieve a low oxygen content.

[0005] The problem in the production of metal powder is the oxygen content. A high oxygen content is unsuitable when metal powder is to be used for tools or other articles requiring high mechanical strength. In US, A, 5,522,914 the problem has been solved by atomising the powder in nitrogen gas atmosphere. This is expensive and results in undesired nitrogen being included in the alloyed powder produced.

[0006] The problem of the added nitrogen is solved by using hydrocarbon which is partially carbonised during the atomisation process. Such use of hydrocarbon is known through Swedish patent application 9601482-4. The atomised steel powder obtained has acquired enriched carbide-bound carbon in the surface layer, and a low oxygen content.

[0007] It has now surprisingly been found that oxidation can be prevented by enriching the carbide-bound carbon in the surface layer. This means that alloyed powder particles can be produced that include oxidation-sensitive alloying substances such as chromium, manganese, silicon. Furthermore, the use of nitrogen gas atmosphere can be avoided since the atmosphere in the atomising equipment is saturated with vaporised or carbonised atomising medium.

[0008] The present invention thus solves the problems of added oxygen and undesired nitrogen. The atomised, alloyed metal powder according to the invention is non-oxidising as well as preventing oxidation. It has improved powder-metallurgical properties such as strength and toughness. The carbide-bound carbon in the surface layer of the powder particles is enriched.

Detailed description of the invention

[0009] The non-oxidising, alloyed metal powder in accordance with the invention comprises oxidation-sensitive alloying metals such as chromium, manganese and/or silicon, besides iron and carbide-bound carbon. These alloying metals are also capable of carbide-binding carbon.

[0010] Atomising medium used in the producion of the non-oxidising alloyed metal powder consists of hydrocarbons selected from the group comprising paraffin, diesel oils, or other cyclic or acyclic hydrocarbons that have been partially carbonised during the atomisation. Hydrogen gas is formed during the carbonisation of the hydrocarbons, as well as the carbides that are bound to the metals in the powder particles. The atmosphere in the atomising vessel is saturated with vaporised or carbonised atomising medium consisting of hydrocarbons and hydrogen gas. The atmosphere is thus reducing, thereby protecting the powder particles produced.

[0011] The alloyed metal powder may also include other alloying substances such as vanadium, molybdenum, tungsten, aluminium, copper, nickel, titanium.

[0012] A preferred embodiment of the invention constitutes atomised, alloyed, non-oxidising metal powder based on iron with enriched carbide-bound carbon in the surface layer, that has been carbide-bound to the metal in the powder particles by carbonised atomising medium selected from the group comprising paraffin, diesel oils, or other cyclic or acyclic hydrocarbons during the atomising, wherein, besides iron and the carbide-bound carbon, the alloyed powder particles comprise one or more of the following alloying substances: 0.1 to 16 % by weight chromium, preferably 0.5 to 12 % by weight, 0.1 to 12 % by weight manganese, preferably 0.5 to 10 % by weight, or 0.1 to 5.0 % by weight silicon, preferably 0.5 to 4.5 % by weight, wherein the carbon content is 0.02 to 3.0 % by weight of the total contents in the metal powder, and wherein the oxygen content is less than 200 ppm.

[0013] Another preferred embodiment of the invention comprises the addition of extra alloying substances to said alloyed non-oxidising metal powder mentioned above. Such extra alloying substances may be, for example, vanadium, molybdenum, tungsten, aluminium, copper, nickel, titanium. Preferred contents of the extra alloying substances are within the range 0.1 to 5.0 % by weight.

[0014] The size distribution in the powder particles is mainly 10 to 350 μm, preferably 45 to 200 μm.

[0015] Producing the atomised, alloyed, non-oxidising

metal powder, based on iron with enriched carbide-bound carbon in the surface layer enables the manufacture of compacted sintered products such as toothed wheels, ball-bearings and tool steel. These products require high mechanical strength and toughness, and these properties are achieved since the alloying additives increase tempering quality and strength. The products are manufactured by means of conventional powder metallurgical compressing, hot compacting and sintering, hot isostatic pressing and sinter forging.

[0016] Since the metal powder produced is non-oxidising and prevents oxidation it can be mixed with other powder produced from oxidation-sensitive metals. This enables the manufacture of composite material having completely new qualities.

[0017] The present invention thus also relates to the use of the atomised, alloyed, non-oxidising metal powder as claimed in any of claims 1 to 6 for the manufacture of compressed, sintered products, such as toothed wheels, ball-bearings, tool steel, manufactured by means of conventional powder-metallurgical compression, hot compacting and sintering, hot isostatic compacting and sinter forging.

[0018] The embodiments described above, and other preferred embodiments of the invention are defined in the subordinated claims.

[0019] The present invention will be further illustrated with concrete examples which should not, however, be considered as limiting the scope of protection of the invention otherwise than as defined in the appended claims.

[0020] In the following, examples of alloyed, non-oxidising metal powder according to the invention were produced in accordance with the procedure described in Swedish patent application No. 9601482-4. Paraffin was used as atomising medium in the experiments.

Example 1

[0021] Alloyed metal powder of type US32CrMn was produced, with the difference that the powder produced has metal carbide in the surface layer. The powder comprises 0.9 to 1.2 per cent by weight chromium, 1.5 per cent by weight manganese and 0.15 to 0.25 per cent by weight molybdenum.

Example 2

[0022] Alloyed metal powder of "Case Hardening Steel" type was produced with metal carbides in the surface layer. The powder comprises 0.8 to 1.3 per cent by weight chromium and 1.1 per cent by weight manganese.

Example 3

[0023] An alloyed metal powder with metal carbides in the surface layer was produced having 8.0 to 10 per cent by weight chromium, 8.0 to 10 per cent by weight manganese, 0.8 to 1.2 per cent by weight carbon and the remainder iron. The powder produced is spherical and has a size distribution of between 45 and 200 μm.

Claims

1. Powder mixture comprising an atomised, alloyed, non-oxidising metal powder based on iron enriched with carbide-bound carbon in the surface layer that has been carbide-bound to the metals by carbonized atomized medium selected from the group comprising paraffin, diesel oils, or other cyclic or acyclic hydrocarbons wherein besides iron and the carbide bound carbon, the powder particles of said non-oxidising metal powder comprise one or more of the alloying substances chromium, manganese or silicon, where the content of chromium is in the range of 0.1 to 16 % by weight, the content of manganese is in the range of 0.1 to 12 % by weight or the content of silicon is in the range of 0.1 to 5.0 % by weight, the carbon content is 0.02 to 3.0 % by weight of the total amount in the non-oxidising metal powder, and the oxygen content is less than 200 ppm in the non-oxidising metal powder, said powder mixture further comprising a powder produced from oxidation sensitive metal.

2. Powder mixture according to claim 1 wherein the alloying substances of the non-oxidising metal powder have contents in the range of 0.5 to 12 % by weight for chromium, 0.5 to 10 % by weight for manganese or 0.5 to 4.5 % by weight for silicon.

3. Powder mixture according to claim 1 or claim 2 wherein the non-oxidising metal powder also includes one or more other alloying metals, such as vanadium, molybdenum, tungsten, aluminium, copper, nickel, titanium.

4. Powder mixture according to any of claims 1 to 3 wherein the powder particles of the non-oxidising metal powder mainly have a size of between 10 and 350 μm.

5. Powder mixture according to any of claims 1 to 3 wherein the powder particles of the non-oxidising metal powder have a size of between 45 and 200 μm.

6. Powder mixture according to any of the preceding claims wherein the powder particles of the non-oxidising metal powder are spherical.

7. Composite material manufactured of the mixture according to any of the preceding claims.

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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 3706

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	28 January 2010	Liu, Yonghe

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X : particularly relevant if taken alone
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