

METHOD OF PRODUCING SINTERED BRONZE ALLOY POWDER

TECHNICAL FIELD

[0001]

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The present invention relates to technology of providing bronze-based sintered powder to be used as the raw material powder for the powder metallurgy of oil-impregnated sintered bearings and the like, and in particular relates to technology of providing bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings.

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BACKGROUND ART

[0002]

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Oil-impregnated sintered bearings utilize the gaps (holes) remaining between the original raw material powder particles within the sintered compact by being manufactured with the powder metallurgical process, and can avoid trouble of lubrication by impregnating a lubricant in such holes.

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As a material that is suitable for oil-impregnated sintered bearings, an alloy (bronze alloy) in which approximately 10% of tin is contained in copper is often used. As the raw material powder of the bronze-based oil-impregnated sintered bearings, mixed powder of copper powder and tin powder, or bronze alloy powder is used.

[0003]

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In the case of mixed powder, since the tin powder will melt during the sintering process and become dispersed and alloyed in the copper powder, large holes (outflow holes) resulting from the melting of the tin powder are formed in the sintered compact. Although these outflow holes are effective for retaining a lubricant, pursuant to the downsizing of the bearings, the existence of large holes is becoming disfavored, and the method of using bronze alloy powder, which does not generate any outflow holes, is becoming popular.

[0004]

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The atomization method can be used as the method of producing the bronze alloy powder, but since the shape of the particles is relatively close to a spherical shape, the strength of the green compact before sintering is weak, and there is a high possibility that defects such as cracks and chipping will occur during the production process. Thus, electrolytic copper powder capable of increasing the strength of the green compact with a random shape is used and mixed with tin

powder, thereafter once sintered and alloyed and pulverized, and the alloy powder of the sintered portion is also often used.

[0005] Meanwhile, in order to deal with the downsizing of bearings pursuant to the miniaturization of motors, holes on the inner peripheral face of the bearings that come in contact with the shaft are being demanded of more fine and uniform distribution. Thus, it is necessary that the raw material powder to be used needs to have a finer particle size than ever before. Nevertheless, generally, the fluidity of powder will aggravate as the particle size distribution of powder becomes finer.

5 Thus, in the case of sintered bronze alloy powder that uses electrolytic copper powder as its raw material, oil-impregnated sintered bearings with finely and uniformly distributed holes can be obtained by using fine electrolytic copper powder as its raw material. But there are problems in that the productivity will deteriorate; for instance, the fluidity of the powder is inferior, the raw material powder cannot be sufficiently filled in a mold during the molding with a pressing machine, and the molding speed cannot be increased.

10 [0006] The present inventors previously proposed a method of producing a bronze powder for sintering by using two types of electrolytic copper powders of different sizes (refer to Patent Document 1). With this method, the fluidity increased and the moldability improved, and the bronze sintered compact showed favorable characteristics. Nevertheless, there were problems in that the production cost is high and the results were not necessarily satisfactory since this bronze powder for sintering required substantially absolute bronze powder.

15 [0007] As an improvement of the foregoing technology, the present inventors devised an invention for producing copper/tin-based powder capable of increasing the moldability such as the compacting density and rattler value of the powder, improving the sintering characteristics such as radial strength, and additionally reducing costs (refer to Patent Document 2). This technology is effective as a method of resolving the foregoing problems.

20 [0008] In the trend of these series of technologies for manufacturing the bronze alloy powder, the present invention provides technology for obtaining bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings.

[0009] [Patent Document 1] Japanese Published Unexamined Patent Application No.S62-

67102

[Patent Document 2] WO 2006/126353

DISCLOSURE OF THE INVENTION

5 [0010]

Oil-impregnated sintered bearings that are used as bearings of various motors of IT-related equipment and the like are being downsized pursuant to the miniaturization of the motors, and an object of this invention is to provide bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings, and additionally provide bronze alloy powder with fluidity that will not deteriorate the productivity even with use of fine raw material powder .

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[0011]

The present inventors discovered that the foregoing problems can be resolved by using sintered bronze alloy powder which uses -200 mesh electrolytic copper powder as its raw material, and devising the sintering conditions.

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[0012]

Based on the foregoing discovery, the present invention provides:

1) A method of producing sintered bronze alloy powder, including a provisional sintering step of sintering copper/tin mixed powder, which is prepared by mixing -200 mesh electrolytic copper powder and -350 mesh tin powder at a tin powder compounding ratio of 8 to 11 wt%, in a reducing atmosphere at 300°C to 600°C and thereafter pulverizing the same, and a main sintering step of sintering the provisionally sintered powder once again in a reducing atmosphere at 500°C to 700°C, wherein the sintered powder is subsequently pulverized and sieved.

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[0013]

The present invention additionally provides:

2) A method of producing sintered bronze alloy powder, including a step of obtaining composite powder by subjecting -200 mesh electrolytic copper powder to tin plating so as to achieve 2 to 10 wt% of tin, a step of mixing -350 mesh tin powder with the composite powder made of tin plated copper to obtain mixed powder that is adjusted so as to achieve a tin ratio of 8 to 11 wt%, a provisional sintering step of sintering the mixed powder in a reducing atmosphere at 300°C to 600°C and thereafter pulverizing the same, and a main sintering step of sintering the provisionally sintered powder once again in a reducing atmosphere at 500°C to 700°C, wherein the sintered powder is subsequently pulverized and sieved.

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[Effect of the Invention]

[0014] With the method of producing the sintered bronze alloy powder according to the present invention, it is possible to provide bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings, and additionally provide bronze alloy powder with fluidity that will not deteriorate the productivity even with use of fine raw material powder.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] Fig. 1 is a micrograph of the -200 mesh copper powder that was used as the raw material.

Fig. 2 is a micrograph of the sintered bronze alloy powder obtained in Example 1.

Fig. 3 is a micrograph of the sintered bronze alloy powder obtained in Comparative Example 1.

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] The electrolytic copper powder that is used as the raw material powder for powder metallurgy in the present invention is generally produced based on a process referred to as electrolysis, and standard electrolytic copper powder that is produced with this process can be used (Reference: "New Powder Metallurgy" by Teruhisa Watanabe, Published by Gijutsu Shoin, Volume 5 Issued on October 15, 1987, pages 15 to 17).

The present invention uses electrolytic copper powder of -200 mesh (200 mesh under) of the electrolytic copper powder that is produced as described. -200 mesh is equivalent to $-75\text{ }\mu\text{m}$ ($75\text{ }\mu\text{m}$ under). With electrolytic copper powder that exceeds the foregoing size, it becomes difficult to produce fine sintered bronze alloy powder.

[0017] As the tin powder to be mixed, standard atomized tin powder can be used. As the tin powder, -350 mesh (350 mesh under) tin powder is used. This is equivalent to $-45\text{ }\mu\text{m}$ ($45\text{ }\mu\text{m}$ under). In this case also, with tin powder that exceeds the foregoing size, it becomes difficult to produce fine sintered bronze alloy powder.

Subsequently, copper/tin mixed powder is obtained by mixing the electrolytic copper powder and tin powder at a tin powder compounding ratio of 8 to

11 wt%. Although this mixing ratio is arbitrary, the foregoing ratio is used to be compatible with copper/tin mixed powder having 9 wt% of tin or 10 wt% of tin as a standard oil-impregnated sintered bearing alloy.

[0018] Next, the copper/tin mixed powder is subject to provisional sintering in a
5 reducing atmosphere at 300°C to 600°C. If the temperature is less than 300°C, there is no change in the tin powder and it will be no different than a simply mixed state. Thus, the temperature is set to be 300°C or higher. Moreover, if the temperature exceeds 600°C, the sintered mass becomes too hard and, when this is pulverized, the shape of the powder becomes round and causes the moldability to deteriorate.
10 Thus, the temperature is set to be 600°C or less.

[0019] After pulverizing the provisionally sintered powder, it is subject to main sintering once again in a reducing atmosphere at 500°C to 700°C. In the foregoing case, at temperature less than 500°C, the sintering will not advance and the fluidity will not improve. Thus, sintering is performed at 500°C or higher. If the temperature
15 exceeds 700°C, the sintered mass becomes too hard and, when this is pulverized, the shape of the powder becomes round and causes the moldability to deteriorate. Thus, the temperature is set to be 700°C or less. This sintered powder is pulverized, and sieved as needed to eliminate coarse powder to obtain the sintered bronze alloy powder.

20 The sintered bronze alloy powder produced as described can be pulverized easily, and fine sintered bronze alloy powder of -100 mesh can be obtained.

[0020] As described above, the purpose of sintering performed in the two stages of provisional sintering and main sintering is to disperse the tin to a certain
25 extent and achieve partial alloying in the provisional sintering, and additionally disperse the tin in the copper in the main sintering. Consequently, it is possible to ameliorate the deterioration of fluidity, which was a drawback in using fine powder, and simultaneously advance the alloying in comparison to the conventional one-stage sintering. Despite the sintered bronze alloy powder obtained as described
30 above is microfine, it is able to maintain sufficient fluidity; specifically a degree of fluidity of 40 s/50 g or less.

[0021] The foregoing explanation showed a case of compounding and mixing tin powder with the electrolytic copper powder. Besides, it is also possible to

perform tin plating to the electrolytic copper powder in advance. In the foregoing case, an effect is yielded in that the mixed condition of copper and tin becomes more favorable, and the alloying of copper and tin can be further promoted upon the completion of sintering.

Here, composite powder is obtained by subjecting -200 mesh electrolytic copper powder to tin plating so as to achieve 2 to 10 wt% of tin. And, -350 mesh tin powder is compounded into the composite powder made of tin plated copper to obtain mixed powder that is adjusted so as to achieve a tin ratio of 8 to 11 wt%.

The subsequent steps are the same as the method described above. Specifically, provisional sintering is performed by sintering the foregoing mixed powder in a reducing atmosphere at 300°C to 600°C, and after pulverizing the same, main sintering is performed once again in a reducing atmosphere at 500°C to 700°C. This sintered powder is additionally pulverized and sieved in order to produce the sintered bronze alloy powder.

Consequently, it is possible to ameliorate the deterioration of fluidity which is a drawback in using fine powder, and simultaneously advance the alloying compared to the conventional one-stage sintering. The sintered bronze alloy powder obtained as described above is able to maintain sufficient fluidity; specifically a degree of fluidity of 40 s/50 g or less.

[Examples]

The Examples of the present invention are now explained. Note that these Examples are merely illustrative and the present invention shall in no way be limited thereby. In other words, various modifications and other embodiments are all covered within the technical spirit of the present invention.

(Example 1)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh (-75 μ m) electrolytic copper powder and 9 wt% of -350 mesh (-45 μ m) tin powder was subject to provisional sintering in a reducing atmosphere at 500°C for 30 minutes.

After the foregoing provisional sintering, the mixed powder was slightly pulverized and coarse powder was eliminated with a 100 mesh (150 μ m) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 650°C for 30 minutes. Subsequently, this was pulverized and coarse powder was

eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

[0025]

The powder characteristics (apparent density, degree of fluidity and particle size distribution) of the -200 mesh (-75 μm) electrolytic copper powder used in Example 1 are shown in Table 1. The degree of fluidity of this powder itself was inferior and it did not flow. The micrograph of this electrolytic copper powder is shown in Fig. 1. The apparent density was 2.10 g/cm^3 . Note that the electrolytic copper powder was also used in the following Examples and Comparative Examples.

The powder characteristics (apparent density, degree of fluidity and particle size distribution) of the sintered bronze alloy powder obtained in Example 1 are shown in Table 2. As shown in Table 2, the apparent density was 2.24 g/cm^3 and the degree of fluidity was 24.6 (s/50 g), and it was possible to obtain usable fluidity. The micrograph of the sintered bronze alloy powder produced with Example 1 is shown in Fig. 2.

Moreover, the green compact strength (rattler value) of the foregoing sintered bronze alloy powder is shown in Table 3. This is the rattler value when the green compact density is 6.0 g/cm^3 . A rattler value of 1.3% was obtained in Example 1. Thus, a proper green compact strength (rattler value) was obtained.

[0026]

[Table 1]

Characteristic items	Raw material copper powder
Apparent density (g/cm^3)	2.10
Degree of fluidity (s/50 g)	(Did not flow)
Particle size distribution (%)	
+150 μm	0.0
+106 μm	0.0
+75 μm	0.1
+63 μm	5.2
+45 μm	12.1
-45 μm	82.6

[0027] [Table 2]

Characteristic items	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Apparent density (g/cm ³)	2.24	2.34	1.95	2.01	2.44	2.55	2.87	1.87	2.66	1.90
Degree of fluidity (s/50 g)	24.6	21.4	33.6	30.3	20.5	19.1	21.3	Did not flow	22.4	Did not flow
Particle size distribution (%)										
+150 μ m	0.0	0.1	0.1	0.0	0.1	0.2	0.2	0.1	0.2	0.1
+106 μ m	9.2	10.5	11.3	3.4	12.6	15.1	34.2	5.5	26.4	10.2
+75 μ m	13.3	13.4	15.1	7.0	16.2	18.6	26.3	6.3	30.8	16.7
+63 μ m	15.1	11.4	12.3	10.3	18.2	18.0	11.1	10.5	13.3	13.4
+45 μ m	27.6	18.5	25.2	22.5	27.6	28.7	12.6	23.5	13.8	26.5
-45 μ m	34.8	46.1	36.1	56.8	25.3	19.4	15.6	54.1	15.5	33.1

[0028] [Table 3]

Characteristic item	Example 1	Example 2	Example 3	Example 4	Example 5	Example 6	Comparative Example 1	Comparative Example 2	Comparative Example 3	Comparative Example 4
Rattler value (%)	1.3	2.3	0.8	0.7	3.7	5.8	15.2	1.1	13.1	3.8

Note) Green compact density: Comparison of rattler value at 6.0 g/cm³

[0029] (Example 2)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh (-75 μ m) electrolytic copper powder and 9 wt% of -350 mesh (-45 μ m) tin powder was subject to provisional sintering in a reducing atmosphere at 300°C for 30 minutes. Subsequently, coarse powder was eliminated from the foregoing mixed powder with a 100 mesh (150 μ m) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 700°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μ m) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. As shown in Table 2, the apparent density was 2.34 g/cm³ and the degree of fluidity was 21.4 (s/50 g), and it was possible to obtain usable fluidity.

Moreover, the green compact strength (rattler value) of the sintered bronze alloy powder was able to achieve a rattler value of 2.3% as shown in Table 3. Thus, a proper green compact strength (rattler value) was obtained. Note that, as with Example 1, this is the rattler value when the green compact density is 6.0 g/cm³.

[0030] (Example 3)

Mixed powder obtained by adding -350 mesh (-45 μm) tin powder to tin plated copper powder with a Sn content of 5.5% prepared by performing tin plating to -200 mesh (-75 μm) electrolytic copper powder, and adjusting the copper/tin ratio to be 91 wt%:9 wt% was subject to provisional sintering in a reducing atmosphere at 500°C for 30 minutes. Subsequently, the mixed powder was slightly pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 650°C for 30 minutes. Subsequently, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. As shown in Table 2, the apparent density was 1.95 g/cm³ and the degree of fluidity was 33.6 (s/50 g), and, although the results were inferior to Examples 1 and 2, it was possible to obtain usable fluidity.

Moreover, the green compact strength (rattler value) of the sintered bronze alloy powder was able to achieve a rattler value of 0.8% as shown in Table 3. Thus, a proper green compact strength (rattler value) was obtained. Note that, as with Example 1, this is the rattler value when the green compact density is 6.0 g/cm³.

(Example 4)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh (-75 μm) electrolytic copper powder and 9 wt% of -350 mesh (-45 μm) tin powder was subject to provisional sintering in a reducing atmosphere at 300°C for 30 minutes. Subsequently, coarse powder was eliminated from the foregoing mixed powder with a 100 mesh (150 μm) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 500°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. As shown in Table 2, the apparent density was 2.01 g/cm³ and the degree of fluidity was 30.3 (s/50 g), and it was possible to obtain usable fluidity.

Moreover, the green compact strength (rattler value) of the sintered bronze alloy powder was able to achieve a rattler value of 0.7% as shown in Table 3.

Thus, a proper green compact strength (rattler value) was obtained. Note that, as with Example 1, this is the rattler value when the green compact density is 6.0 g/cm^3 .

[0032] (Example 5)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh (-75 μm) electrolytic copper powder and 9 wt% of -350 mesh (-45 μm) tin powder was subject to provisional sintering in a reducing atmosphere at 600°C for 30 minutes. Subsequently, coarse powder was eliminated from the foregoing mixed powder with a 100 mesh (150 μm) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 500°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. As shown in Table 2, the apparent density was 2.44 g/cm^3 and the degree of fluidity was 20.5 (s/50 g), and it was possible to obtain usable fluidity.

Moreover, the green compact strength (rattler value) of the sintered bronze alloy powder was able to achieve a rattler value of 3.7% as shown in Table 3. Thus, a proper green compact strength (rattler value) was obtained. Note that, as with Example 1, this is the rattler value when the green compact density is 6.0 g/cm^3 .

[0033] (Example 6)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh (-75 μm) electrolytic copper powder and 9 wt% of -350 mesh (-45 μm) tin powder was subject to provisional sintering in a reducing atmosphere at 600°C for 30 minutes. Subsequently, coarse powder was eliminated from the foregoing mixed powder with a 100 mesh (150 μm) sieve. The foregoing powder was additionally subject to main sintering in a reducing atmosphere at 700°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. As shown in Table 2, the apparent density was 2.55 g/cm^3 and the degree of fluidity was 19.1 (s/50 g), and it was possible to obtain usable fluidity.

The green compact strength (rattler value) of the sintered bronze alloy

powder was able to achieve a rattler value of 5.8% as shown in Table 3. Thus, a proper green compact strength (rattler value) was obtained. Note that, as with Example 1, this is the rattler value when the green compact density is 6.0 g/cm^3 .

[0034] (Comparative Example 1)

5 Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh ($-75 \mu\text{m}$) electrolytic copper powder and 9 wt% of -350 mesh ($-45 \mu\text{m}$) tin powder was subject to provisional sintering in a reducing atmosphere at 500°C for 30 minutes. After the foregoing provisional sintering, the mixed powder was slightly pulverized and coarse powder was eliminated with a 100 mesh ($150 \mu\text{m}$) sieve. Subsequently, 10 the foregoing powder was sintered in a reducing atmosphere at 750°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh ($150 \mu\text{m}$) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. In 15 Comparative Example 1, the temperature of main sintering was 750°C , and the results are obtained from sintering at a higher temperature than the conditions of the present invention.

The apparent density was 2.87 g/cm^3 and the degree of fluidity was 21.3 (s/50 g) and usable fluidity was obtained, but pulverization become difficult since the 20 sintered mass became hardened, and the shape of the pulverized powder was round. The micrograph of this sintered bronze alloy powder is shown in Fig. 3.

Consequently, the rattler value as the index of the strength of the green compact deteriorated to 15.2%. Moreover, the coarse powder (+100 mesh) became more than 30% in the sieving after the pulverization, and the productivity also 25 deteriorated.

[0035] (Comparative Example 2)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh ($-75 \mu\text{m}$) electrolytic copper powder and 9 wt% of -350 mesh ($-45 \mu\text{m}$) tin powder was 30 sintered in a reducing atmosphere at 650°C for 30 minutes, thereafter pulverized, and coarse powder was eliminated with a 100 mesh ($150 \mu\text{m}$) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. In

Comparative Example 2, provisional sintering was not performed, and the results are obtained from producing the sintered bronze alloy powder with a single sintering process. The apparent density was 1.87 g/cm^3 .

Meanwhile, the fluidity of the powder was so inferior that the degree of fluidity could not be measured; because during the measurement of such degree of fluidity, the powder would stop without a constant flow downward from the funnel. The rattler value as the index of the strength of the green compact was 1.1%.

(Comparative Example 3)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh ($-75 \mu\text{m}$) electrolytic copper powder and 9 wt% of -350 mesh ($-45 \mu\text{m}$) tin powder was subject to provisional sintering in a reducing atmosphere at 250°C for 30 minutes. After the foregoing provisional sintering, the mixed powder was slightly pulverized and coarse powder was eliminated with a 100 mesh ($150 \mu\text{m}$) sieve. Subsequently, the foregoing powder was sintered in a reducing atmosphere at 750°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh ($150 \mu\text{m}$) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. In Comparative Example 3, the temperature of provisional sintering was 250°C and the temperature of main sintering was 750°C , and the results are obtained from sintering at a lower temperature than the conditions of the present invention in the provisional sintering and sintering at a higher temperature than the conditions of the present invention in the main sintering.

The apparent density was 2.66 g/cm^3 and the degree of fluidity was 22.4 (s/50 g) and usable fluidity was obtained, but pulverization become difficult since the sintered mass became hardened, and the shape of the pulverized powder was round as with Comparative Example 1.

Consequently, the rattler value as the index of the strength of the green compact deteriorated to 13.1%.

(Comparative Example 4)

Cu - 9% Sn mixed powder obtained by mixing 91 wt% of -200 mesh ($-75 \mu\text{m}$) electrolytic copper powder and 9 wt% of -350 mesh ($-45 \mu\text{m}$) tin powder was subject to provisional sintering in a reducing atmosphere at 650°C for 30 minutes.

After the foregoing provisional sintering, the mixed powder was slightly pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve. Subsequently, the foregoing powder was sintered in a reducing atmosphere at 450°C for 30 minutes. In addition, this was pulverized and coarse powder was eliminated with a 100 mesh (150 μm) sieve to obtain sintered bronze alloy powder.

The results are shown in Table 1, Table 2, and Table 3. As the raw material copper powder, the same copper powder as Example 1 was used. In Comparative Example 4, the temperature of provisional sintering was 650°C and the temperature of main sintering was 450°C, and the results are obtained from sintering at a higher temperature than the conditions of the present invention in the provisional sintering and sintering at a lower temperature than the conditions of the present invention in the main sintering. The apparent density was 1.90 g/cm³. Although the powder obtained as described above flowed slightly, the degree of fluidity could not be measured, since the flow of powder would stop without flowing downward constantly from the funnel during the measurement of such degree of fluidity; and usable fluidity could not be obtained.

The rattler value as the index of the strength of the green compact was favorable at 3.8%, but it was unsuitable as the raw material powder for bearings since the fluidity was inferior.

INDUSTRIAL APPLICABILITY

[0038]

As described above, with the method of producing the sintered bronze alloy powder according to the present invention, it is possible to yield superior effects of being able to provide bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings, and additionally provide bronze alloy powder with fluidity that will not deteriorate the productivity even with use of fine raw material powder. Thus, the present invention is effective as the bronze-based sintered powder to be used as the raw material powder for the powder metallurgy of oil-impregnated sintered bearings and the like, and particularly as the bronze alloy powder having a fine particle size which is suitable for the manufacture of compact oil-impregnated sintered bearings.

CLAIMS

1. A method of producing sintered bronze alloy powder, including a provisional sintering step of sintering copper/tin mixed powder, which is prepared by mixing -200 mesh electrolytic copper powder and -350 mesh tin powder at a tin powder compounding ratio of 8 to 11 wt%, in a reducing atmosphere at 300°C to 600°C and thereafter pulverizing the same, and a main sintering step of sintering the provisionally sintered powder once again in a reducing atmosphere at 500°C to 700°C, wherein the sintered powder is subsequently pulverized and sieved.

2. A method of producing sintered bronze alloy powder, including a step of obtaining composite powder by subjecting -200 mesh electrolytic copper powder to tin plating so as to achieve 2 to 10 wt% of tin, a step of mixing -350 mesh tin powder with the composite powder made of tin plated copper to obtain mixed powder that is adjusted so as to achieve a tin ratio of 8 to 11 wt%, a provisional sintering step of sintering the mixed powder in a reducing atmosphere at 300°C to 600°C and thereafter pulverizing the same, and a main sintering step of sintering the provisionally sintered powder once again in a reducing atmosphere at 500°C to 700°C, wherein the sintered powder is subsequently pulverized and sieved.