

Description

The present invention relates to a method for manufacturing a precious metal article for ornaments, artistic handicrafts or the like and further to a moldable mixture specifically adapted to be employed in the manufacture of the precious metal article and a method for producing the moldable mixture itself.

Japanese Patent Application laid open with Publication No. 59-143001 describes one conventional method for manufacturing ornamental articles or artistic handicrafts, which involves preparing powders of precious metal such as gold (Au), platinum (Pt) and silver (Ag); adding binders such as clay, glue, boiled rice or wheat flour to them; subsequently mixing them together with water to produce a moldable mixture; modeling an article of a prescribed shape in this moldable mixture; and drying the resulting article at about 100°C.

Japanese Patent Application laid open with Publication No. 63-403 describes another conventional manufacturing method which includes preparing powder of metal such as nickel (Ni); adding bentonite as binder; mixing them together with water to produce a moldable mixture; modeling an article of a prescribed shape in this mixture; leaving the resulting article at room temperature for a prolonged period of time to remove water; and subsequently sintering it in a reducing atmosphere at 1,250°C.

In the above methods, various binders such as clay, glue, boiled rice, wheat flour or bentonite are added. However, these kinds of binders remain in the article in a considerable amount even after the completion of drying or sintering, and mar the color tone of the articles. Particularly, in the articles of precious metal, the special color tone of precious metal cannot be successfully reproduced.

Patent Abstracts of Japan, Vol. 13, No. 13 (M-783) (JP-A-63-223 102) discloses the production of a composite noble metal alloy product. A powder of light metals coated with nickel, a noble metal powder and a binder are mixed. Such a powder mixture is subjected to injection moldings. Thereafter, the moldings are heated to evaporate the binder. Then the moldings are sintered and afterwards gold-plated.

US-A-4,369,068 which discloses all the features of the preamble of claim 12 and describes a preparation consisting essentially of gold powder, an adhesive and a binder of an organic solvent and a resin. The adhesive is a metal powder. As the resin, ethyl cellulose may be used. The binder is liquid at room temperature and is volatilized or burned at firing temperature. Said preparation is used for coating metallic particles.

It is therefore a primary object of the present invention to provide a precious metal article which contains no binder so that the special color tone of precious metal can be positively reproduced by a method specifically adapted to manufacture it.

Yet another object is to provide a moldable mixture adapted to be used in the above method of manufacturing the precious metal articles.

A further object is to provide a method for producing the moldable mixture itself.

According to a first aspect of the invention, there is provided a method for manufacturing a precious metal article consisting essentially of a solid-phase sintered product of a precious metal powder free of any binder, whereby assuming color tone of the precious metal, comprising preparing a moldable mixture consisting essentially of: 50 to 90 % by weight of a precious metal powder; 0.8 to 8 % by weight of a water-soluble cellulose binder; 0.03 to 3 % by weight of a surface-active agent; 0.1 to 3 % by weight of an adhesion-preventing agent; and balance water and unavoidable impurities, wherein said binder is removable by sintering, shaping the moldable mixture into a prescribed molded object, and subjecting the molded object to solid-phase sintering operation to provide the precious metal article. Various methods can be developed by using the basic idea of this method, and various kinds of precious metal articles of high quality can be successfully produced.

According to a second aspect of the invention, there is provided a moldable mixture for use in the manufacture of a precious metal article, containing a precious metal powder and a binder consisting essentially of 50 to 90 % by weight of a precious metal powder; 0.8 to 8 % by weight of a water-soluble cellulose binder; 0.03 to 3 % by weight of a surface-active agent; 0.1 to 3 % by weight of an adhesion-preventing agent; balance water and unavoidable impurities.

It is required that the binder employed to prepare the moldable mixture be removable during the manufacture of the precious metal article. It has been found that the cellulose binder is particularly suitable for these purposes. Furthermore, in order to impart other characteristics as necessary, the moldable mixture can be modified in various ways.

Finally, according to a third aspect of the invention, there is provided a method for producing a moldable mixture for use in the manufacture of a precious metal article, comprising the steps of preparing a precious metal powder, preparing a jelly-like cellulose binder by blending a cellulose with water and leaving for a prescribed period of time, blending the precious metal powder and the jelly-like cellulose binder

together, and adding 0.03 to 3 % by weight of a surface-active agent and 0.1 to 3 % by weight of an adhesion-preventing agent. Said surface-active agent and adhesion-preventing agent are added in order to obtain a better moldable mixture.

5 BRIEF DESCRIPTION OF THE DRAWINGS

Figs. 1a to 1d are schematic views showing the respective steps of a manufacturing method of a precious metal article in accordance with a first embodiment of the invention;

10 Figs. 2a to 2d are views similar to Figs. 1a to 1d, but showing a manufacturing method of a precious metal article in accordance with a second embodiment of the invention;

Figs. 3a and 3b are views similar to the above, but showing a manufacturing method in accordance with a third embodiment of the invention;

Figs. 4a and 4b are views showing a modification of the method shown in Figs. 3a and 3b;

15 Figs. 5a to 5e are views similar to the above, but showing a manufacturing method in accordance with a fourth embodiment of the invention;

Figs. 6a to 6c are views showing a modification of the method shown in Figs. 5a to 5e;

Figs. 7a to 7c are views showing another modification of the method shown in Figs. 5a to 5e;

Figs. 8a to 8d are views similar to the above, but showing a manufacturing method in accordance with a fifth embodiment of the invention; and

20 Fig. 9 is a schematic enlarged view showing particles of a precious metal powder in accordance with a preferred embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

25 The inventors have made an extensive study to obtain a precious metal article containing no binder, and have come to know that when a jellylike cellulose, prepared by adding water to cellulose, is used as a binder, water contained therein evaporates during the drying process while the cellulose disappears during the solid-phase sintering process. Thus, the resulting metal article is free of binder, and is essentially comprised of a solid-phase sintered product of a precious metal. Furthermore, the inventors have come to
30 understand that if a surface-active agent is added during the mixing of binder and precious metal, a uniform mixing in a short period of time can be positively ensured. Moreover, if an adhesion-preventing agent such as di-n-butyl phthalate is mixed with the aforesaid mixture, the mixture is prevented from sticking to hand during the molding work, and this adhesion-preventing agent as well as the aforesaid surface-active agent can be removed away during the sintering step, so that the color tone of the resulting metal article is not
35 marred.

Thus, the precious metal article made in accordance with the method of the present invention consists essentially of a solid-phase sintered product of a precious metal powder free of any binder, and assumes the special color tone of the precious metal.

40 According to the present invention, the precious metal article is manufactured by the steps of preparing a moldable mixture containing a precious metal, a binder which is removable by sintering, a surface-active agent and an adhesion-preventing agent and subjecting the mixture to solid-phase sintering operation.

More specifically, there is first prepared a moldable mixture containing a precious metal powder and a cellulose binder mixed with the powder. The use of the cellulose as the binder ensures that the binder be removed away during the sintering step.

45 Then, the moldable mixture of a precious metal is molded into a prescribed shape, and after being dried, the molded object is sintered under predetermined conditions. Thus, the binder is removed during the sintering operation, and a precious metal article free of the binder is manufactured.

Various modifications of the manufacturing method of a precious metal article will now be described.

50 Figs. 1a to 1d are schematic views showing the steps of the above method in accordance with a first preferred embodiment of the invention. In this method, a leaf 1 as shown in Fig. 1a is prepared as a combustible base object. It is preferable that a leaf of tree having a distinct vein be selected. Subsequently, as shown in Fig. 1b, the moldable mixture of the invention is extended thinly by hand on the surface of the leaf 1 and unnecessary portion of the mixture is removed by a bamboo spatula or the like in conformity with the shape of the leaf 1 to provide a molded object 2 having the same shape as the leaf 1. Then, as shown
55 in Fig. 1c, the molded object 2 is introduced into an electric furnace 3, and subjected to solid-phase sintering operation. The sintering conditions in the electric furnace 3 differ depending upon the kinds of the moldable mixture. When the mixture is of pure gold, it may be heated in air at 1000°. However, when the mixture is of an alloy of 75.0% by weight of gold, 12.5% by weight of silver and 12.5% by weight of copper,

i.e., 18-carat gold, it may be heated in an argon gas atmosphere at 800°C. During this sintering operation, the leaf 1 burns to ash, so that it can be easily removed away. With these procedures, a precious metal article 4 having a minute venous pattern reproduced from the surface of the leaf 1 can be obtained as shown in Fig. 1d.

In the above method, if it is desired to reproduce the vein patterns on both of the faces of the precious metal article 4, the moldable mixture is first extended thinly on the leaf 1 as shown in Fig. 1b, and then another leaf is placed thereon in such a manner that the mixture is sandwiched between the two leaves. Then, the sintering step is carried out under the same conditions as described above. In the foregoing, leaves of trees are selected as base objects, but other combustible materials such as paper pattern having a desired design thereon may be employed as well.

Figs. 2a to 2d are schematic views showing the steps of the manufacturing method in accordance with a second preferred embodiment of the invention. In this embodiment, an object of wax 5 as shown in Fig. 2a is prepared as a base object which is removable by sintering. Then, as shown in Fig. 2b, a moldable mixture of the invention is extended thinly by hand on the outer surface of the object 5 and unnecessary portion of the mixture is removed by a bamboo spatula or the like to provide a molded object 6 of a prescribed shape as shown in Fig. 2b. Then, as shown in Fig. 2c, the molded object 6 is introduced into an electric furnace 7, and is subjected to solid-phase sintering by heating it at 1000°C in air. The sintering conditions in the electric furnace 3 are the same as those previously mentioned. With the sintering step, the wax quickly evaporates, and hence only the molded object 6 is left as a precious metal article 8. In the foregoing, the wax may be replaced by any other material which is vaporizable or liquefiable during the sintering.

Figs. 3a and 3b are schematic views showing the steps of the manufacturing method in accordance with a third embodiment of the invention. This embodiment is in particular suitable for manufacturing relatively small-size ornamentations such as pendants. First, a moldable mixture of the invention is placed on a working table 9 and extended thereon by a roller or the like to produce a plate 10 of the moldable mixture. Then, as shown in Fig. 3b, a prescribed portion 10a is carved and punched into a desired shape using a bamboo spatula or the like to provide a molded object. When required to manufacture many precious metal articles, it is preferable to use prescribed dies. The molded object thus obtained is introduced into an electric furnace and subjected to solid-phase sintering operation under the same conditions as described above.

This method may be further modified so as to be suitably adapted for manufacturing artistic handicrafts of a relatively large size such as picture platters. More specifically, as shown in Fig. 4a, the above procedures are repeated to produce a plate 10 of mixture, and a prescribed portion 10b is removed away using a bamboo spatula. Then, as shown in Fig. 4b, another moldable mixture 10c, which assumes a color tone different from that of the plate 10, is stuffed into the vacant portion 10b of the plate 10 to provide a molded object. Then, the sintering operation is effected in a similar way. In this case, two or more portions may be removed from the plate, and moldable mixtures of different colors may be stuffed thereinto, respectively.

Figs. 5a to 5e are schematic views showing the steps of the manufacturing method in accordance with a fourth embodiment of the invention. First, as shown in Fig. 5a, a plurality of plates of moldable mixtures 11 and 12, which assume different colors after the sintering operation, are prepared and formed flat by a roller. Then, as shown in Fig. 5b, the mixtures 11 and 12 are placed one upon another with alternations of different colors. Thereafter, as shown in Fig. 5c, the plates of mixtures are vertically cut in pieces each having a stripe pattern, and as shown in Fig. 5d, these stripe pieces are piled one upon another in such a manner that the mixtures of different colors are displaced adjacent to each other. Then, after having trimmed the ends, the piled mixtures are sliced in a prescribed direction to produce sliced plates each having a checker pattern as shown in Fig. 5e. Sliced plates thus obtained are sintered in an electric furnace or the like under the same conditions as described above, so that precious metal articles having checker patterns can be obtained.

The method shown in 6a to 6c is another modification, wherein a moldable mixture 13 is shaped into a rectangular parallelepiped, and a plurality of apertures of a prescribed cross-sectional shape are formed therethrough. Then, another moldable mixture 14 of different color is stuffed into each of the apertures. In this case, moldable mixtures 14 of different colors may be stuffed. The rectangular parallelepiped thus formed is cut into slices each having a pattern in which plural isolated portions of different color are scattered. These sliced plates are then sintered under the same conditions as described above.

This method may be further modified as shown in Figs. 7a to 7c. In this modification, two plates 15 and 16 of different moldable mixtures are placed one upon another, and are wound round as depicted in Fig. 7b. The cylindrical mixtures thus formed are then sliced into circular disks each having a vortex pattern. These

disks are finally sintered in a furnace to provide precious metal articles having vortex patterns.

In the foregoing, two or more moldable mixtures may be blended together before the molding operation. With this modification, precious metal articles having complicated patterns can be obtained. Moreover, the article obtained by the sintering operation may be further subjected to plastic working to thereby modify the shape of the article.

Figs. 8a to 8d are schematic views showing the steps of the manufacturing method in accordance with a fifth embodiment of the invention. This embodiment is also suitable for manufacturing relatively small-size ornamental articles such as pendants. First, a prescribed moldable mixture is placed on a working table and extended thereon by a roller or the like, and shaped by handwork with a bamboo spatula or the like or punching operation into a heart-shaped molded object 17 as shown in Fig. 8b. Then, as shown in Fig. 8b, powdered glass 18 is caused to adhere to its surface at a prescribed portion thereof, and is sintered in a furnace 19 under the same conditions as described above. Thus, as is the case with cloisonne, a glassy layer 20 is formed on a desired portion on the surface, and a precious metal article 21 having a glassy portion 20 on its surface can be obtained. This article 21 is, for example, secured to a necklace 22.

In the foregoing, if a coloring agent is mixed into the powdered glass, a glassy layer of a desired color can be obtained. The shape of the article is of course arbitrary. Furthermore, a suitable jewel may be directly attached to the moldable mixture before the sintering operation. With this procedure, the jewel attached to the mixture remains in the resulting article as it is, so that a precious metal article having a jewel secured thereto in advance can be obtained.

Next, the moldable mixture for use in the manufacture of the above precious metal article and the method for producing the same will be described.

As previously mentioned, the moldable mixture in accordance with the invention is characterized in that it contains a precious metal powder and a cellulose binder mixed with the powder. The use of the cellulose as the binder ensures that the binder is removed away during the sintering step. For producing the moldable mixture, a water-soluble cellulose is prepared and blended with water, and is left for a predetermined period of time to thereby produce a jellylike cellulose binder. It is preferable that cellulose and water are blended at a ratio of cellulose to water ranging from 5/95 to 30/70. Then, the resulting binder and a prescribed precious metal powder are blended preferably in an amount of 7 to 33 % by weight with respect to the total amount of the mixture.

In the foregoing, it is more preferable that 0.05 to 5 % by weight of a surface-active agent such as alkyl benzene sodium sulfonate or polysoap and/or 0.5 to 10 % by weight of an adhesion-preventing agent such as oil may be added to the jellylike substance and mixed together. Thus, the mixture is such that it contains the surface-active agent and the adhesion-preventing agent, and consists essentially of 50 to 90% by weight of the precious metal powder, 0.8 to 8% by weight of the water-soluble cellulose binder, 0.03 to 3% by weight of the surface-active agent and 0.1 to 3% by weight of the adhesion-preventing agent, balance water and unavoidable impurities. This moldable mixture is prepared by blending cellulose binders with water to leave them for a while until jelly substance is formed, adding the active-surface agent to the jelly substances and mixing them together, mixing the precious metal powder therewith, and further adding the adhesion-preventing agent to produce the moldable mixture.

The reasons for the limitations on the composition of the most preferred moldable mixture are as follows:

(a) Precious metal powder:

Powders of precious metal such as gold, silver, copper, platinum and their alloys are main constituents for the moldable material to be obtained. If the content is less than 50% by weight, desired effects cannot be obtained. On the other hand, if the content exceeds 90% by weight, the resulting moldable material is inferior in extensibility and strength. Therefore, the content of the precious metal powder has been determined so as to range from 50 to 90% by weight.

In addition, if the average particle size of the precious metal powder exceeds 200 μ m, the extensibility and strength are deteriorated. Therefore, it is preferable that the average particle size of the precious metal powder is no greater than 200 μ m.

(b) Water-soluble cellulose binder:

When heated, the water soluble binder is quickly gelled, so that it is very easy to keep the shape of the molded article. However, if the binder content is less than 0.8% by weight, such an advantage cannot be obtained. On the other hand, if the content exceeds 8% by weight, fluidity is unduly increased, so that it

becomes difficult to mold the mixture. Therefore, the content of the cellulose binder is determined so as to range from 0.8 to 8% by weight.

In the foregoing, methyl cellulose and/or ethyl cellulose are favorably used as the water-soluble binder of the above kind.

(c) Surface-active agent:

A surface-active agent breaks solid substances which are formed by the reaction of the binder with water, and facilitates an efficient mixing of the precious metal powder with the binder. However, if its content is less than 0.03% by weight, desired effects cannot be obtained. On the other hand, if the content exceeds 3% by weight, the fluidity of the moldable mixture is unduly reduced, so that molding operation cannot be smoothly carried out. Accordingly, the content of the surface-active agent to be added is determined so as to range from 0.03 to 3% by weight. As described above, polysoap or alkyl benzene sodium sulfonate is preferable as this agent.

(d) Adhesion-preventing agent:

When a small amount of adhesion-preventing agent, or oil and fat, is added, the moldable mixture is prevented from sticking to hand during the molding operation. However, if the content is less than 0.1% by weight, the effects cannot be obtained. On the other hand, if the content exceeds 3% by weight, the moldable mixture becomes oily and slippery, resulting in poor handling characteristics. Therefore, the content of the adhesion-preventing agent is determined so as to range from 0.1 to 3% by weight.

This agent may include higher organic acid such as phthalic acid, higher organic ester such as di-n-octyl phthalate or di-n-butyl phthalate, higher alcohol, higher polyhydric alcohol such as polyvinyl alcohol, polyethylene glycol, and higher ether.

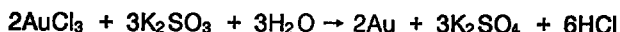
Furthermore, it has been found that when ethylene glycol is added in an amount of no greater than 30 % by weight, preferably 2 to 10 % by weight, with respect to water, the moldability of the resulting mixture can be further improved. However, if the content exceeds 30 % by weight, the viscosity is reduced, so that the moldability deteriorates instead.

Moreover, the precious metal powder to be used in the manufacture of the moldable mixture of the invention will be hereinafter explained.

The precious metal powder to be used in the invention may contain various kinds of precious metal powders. As described above, the moldable mixtures of different colors may be used in the invention. In this case, the color can be controlled by the blending composition of the powder. More specifically, in order to emphasize whitish color, a precious metal powder containing an increased amount of palladium (Pd), nickel, silver or the like is preferably used, while the reddish color tone can be achieved by increasing the copper content.

Furthermore, in the precious metal powder to be used in the invention, gold powder is mainly utilized, but powder of an alloy of various precious metals is also contained in order to control the moldability of the mixture and the strength and color tone of the resulting precious metal article. Since it is impossible to produce the alloy powder by submerged-reduction method, the alloy powder as well as the gold powder are conventionally manufactured by a gas atomizing process. However, when manufactured by the gas-atomizing process, the average particle sizes of the obtained powders are varied widely, so that a moldable mixture having excellent and stable quality cannot be obtained.

In order to overcome the above problems, gold powder is manufactured by means of submerged reduction method, and the alloy powder is manufactured by gas-atomizing method. More specifically, 5 l of aqueous AuCl_3 solution having a concentration of 46 g/l and 5 l of aqueous K_2SO_3 solution having a concentration of 70 g/l are quickly blended at a temperature of -10°C to $+5^\circ\text{C}$, preferably at 2°C . With this procedure, the following reaction takes place, and particles of gold powder precipitates in 5 to 10 seconds.



Then, these precipitates are filtered to produce gold powder. The gold thus obtained has a particle size of about 10 to $100\mu\text{m}$, and each individual particle of the powder has protuberances of about 0.1 to $1\mu\text{m}$ adherent thereto. With these constructions, when the gold powder is blended together with the binder and/or the other precious metal powder, their particles get caught in the binder and/or the other alloy powder, so that the moldable mixture produced using this powder exhibits an excellent quality.

In the foregoing, if the temperature of the aqueous solution is less than -10°C , the rate of reaction is reduced. On the other hand, if the temperature exceeds 5°C , the obtained particles become small in size, so that the particles flocculate.

Furthermore, as described above, the alloy powders which are to be blended with the above gold powder are manufactured by means of gas-atomizing method. Namely, alloy powder containing silver or copper, alloy powder containing nickel or palladium, or alloy powder containing zinc (Zn), cobalt (Co), beryllium (Be), tin (Sn) or indium (In) is manufactured. With respect to the powder containing silver or copper, the hardness, strength, color tone and the like of the moldable mixture can be changed by controlling the content. Also, nickel or palladium is suitable to emphasize white. Zinc is effective to regulate the color tone. Cobalt, beryllium, tin or indium enhances the strength of the moldable mixture. These powders may be manufactured in the state of alloy, but may be produced by blending the individual precious metal powders which have been independently produced.

The gold powder and the alloy powder thus obtained are blended together such that gold versus alloy is 75% : 25%. Fig. 9 is a view schematically showing the particles of gold and alloy thus obtained, in which the gold powder and the alloy powder are designated by the numerals 23 and 24, respectively.

The present invention will now be described in more detail by way of the following examples:

Example 1

Methyl cellulose, selected as water-soluble cellulose binder, was mixed with water and left over night to produce gelatinous substances. A surface-active agent was added to the gelatinous substances and mixed in a mortar, and then powder of gold having an average particle size of $20\mu\text{m}$ was added thereto. After mixed in the mortar again, di-n-butyl phthalate was added to the mixture and mixed in the mortar. Thus, moldable mixtures 1 to 22 of the invention and comparative moldable mixtures 1 to 8 each having the composition as set forth in Tables 1-1 and 1-2 were manufactured.

Furthermore, prior art moldable mixture 1 containing gold powder which is used in a conventional doctor blade method, was prepared, and prior art moldable mixture 2 was also produced by adding bentonite powder and water to the above gold powder.

20g of each of the moldable mixtures 1 to 22 of the invention, the comparative moldable mixtures 1 to 8 and the prior art moldable mixtures 1 and 2 was molded into a sphere, and placed between the upper and lower molds. Then, the material was pressed until the thickness reached 1.0 mm, and the resulting pressed compacts were taken out from the molds. Furthermore, the weight of the moldable mixture adhering to the surfaces of the upper and lower molds were measured. The results are shown in Tables 1-1 and 1-2.

Subsequently, the pressed compacts were introduced into an electric furnace without drying them, and were heated at a heating speed of $20^{\circ}\text{C}/\text{min}$ and sintered by holding them in air atmosphere at 1050°C for one hour. Then the existence of cracks on the surface of the sintered products were observed, and the results are also set forth in Tables 1-1 and 1-2.

As will be seen from Tables 1-1 and 1-2, the prior art moldable mixture 1 cannot be molded due to unduly high fluidity, while the prior art moldable mixture 2 much adhered to the upper and lower molds and cracks were developed in the sintered product. In contrast, with respect to the moldable mixtures 1 to 22 of the invention, the amount adhering to the upper and lower molds are extremely small, and no cracking was observed even when the pressed compacts were sintered in an electric furnace without drying.

Furthermore, it is seen from the results that defects shown in Tables 1-1 and 1-2 occur in the comparative moldable mixtures 1 to 8, in which the values falling outside the ranges of the invention are marked by the symbols *.

Example 2

Various jelly binders were prepared by blending cellulose so as to have compositions set forth in Table 2, and polysoap was blended as accelerator for mixing. Then, precious metal powders having an average particle size of no greater than $15\mu\text{m}$ were blended to produce moldable mixtures, and further di-n-butyl phthalate was mixed as an adhesion-preventing agent in an amount as set forth in Table 2. Using the moldable mixtures thus prepared, annular molded articles having an outer diameter of 17 mm, an inner diameter of 15 mm and a thickness of 1 mm were molded. Thereafter, the molded articles were subjected to drying and sintering under the conditions as set forth in Table 1 to provide precious metal articles 1 to 12 of the invention.

Then, the resulting articles were tested as to the theoretical density ratio and precious metal content. The results are set forth in Table 1.

As will be seen from Table 1, it is clear that the precious metal articles 1 to 12 of the invention contain substantially no binders, surface-active agents and/or adhesion-preventing agents.

Obviously many modifications and variations of the present invention are possible in the light of the above. It is therefore to be understood that within the scope of the appended claims, the invention may be practiced otherwise than as specifically described.

Table 1-1

	Composition of moldable mixture (wt%)						Residual mixture adherent to dics (mg)	Presence of cracks	Remarks
	Au powder	Ethyl cellulose	Surface active agent	Di-n-butyl phthalate	Ethylene glycol	Water & impurities			
1	50	5.0	0.5	0.5	—	bal.	1	none	not deformed
2	60	4.0	0.4	0.4	—	bal.	1	none	not deformed
3	70	2.5	0.2	0.5	—	bal.	1	none	not deformed
4	80	2.5	0.2	1.0	—	bal.	1	none	not deformed
5	90	2.0	0.2	1.0	—	bal.	1	none	not deformed
6	80	0.8	0.04	1.0	—	bal.	1	none	not deformed
7	80	2.0	0.4	0.7	—	bal.	1	none	not deformed
8	80	4.0	1.0	2.0	—	bal.	1	none	not deformed
9	70	6.0	2.0	2.5	—	bal.	1	none	not deformed
10	50	8.0	2.0	2.5	—	bal.	1	none	not deformed
11	70	2.5	0.03	1.0	—	bal.	1	none	not deformed
12	70	2.5	0.1	1.0	—	bal.	1	none	not deformed
13	70	2.5	1.0	1.0	—	bal.	1	none	not deformed
14	80	3.0	2.0	1.0	—	bal.	1	none	not deformed
15	50	8.0	3.0	1.0	—	bal.	1	none	not deformed
16	80	2.5	0.2	0.1	—	bal.	1	none	not deformed
17	80	2.5	0.2	1.0	—	bal.	1	none	not deformed
18	80	2.5	0.2	2.0	—	bal.	1	none	not deformed
19	70	2.5	0.2	3.0	—	bal.	1	none	not deformed
20	60	4.0	0.4	0.4	0.5	bal.	1	none	not deformed
21	70	2.5	0.2	0.5	2.0	bal.	1	none	not deformed
22	50	5.0	0.5	0.7	11.0	bal.	1	none	not deformed

Moldable mixtures of the invention

Table 1-2

	Composition of moldable mixture (wt%)				Residual mixture adherent to dies (mg)	Presence of cracks	Remarks
	Au powder	Ethyl cellulose	Surface active agent	Di-n-butyl phthalate	Water & impurities		
1	40 *	5.0	0.5	0.5	balance	none	sintered product was deformed
2	97 *	2.0	0.2	0.5	balance	presence	slightly inferior in plasticity
3	70	0.3 *	0.1	1.0	balance	presence	sintered product was deformed
4	70	9.0 *	0.5	1.0	balance	none	inferior in plasticity
5	70	2.5	0.01 *	1.0	balance	presence	a number of pores observed
6	70	2.5	4.0 *	1.0	balance	none	unable to mold by hand due to great fluidity
7	80	2.5	0.2	0.05 *	balance	none	—
8	80	3.0	0.3	4.0 *	balance	none	oily and slippery, poor handling characteristics
1	75	0.5	0.01	Polyvinyl alcohol	balance	none	unable to mold by hand due to great fluidity
2	92	Bentonite:5			0.2	presence	—

* denotes the values falling outside the ranges of the invention.

Table 2

Precious metal articles of the invention	Blending composition (wt%)										Drying conditions			Solid-phase sintering conditions			Precious metal article	
	Precious metal powder			Binder (weight ratio)				Polysoap	Di-n-butyl phthalate	Atmosphere	Temp. (°C)	Time (hour)	Atmosphere	Temp. (°C)	Time (hour)	Theoretical density ratio (%)	Precious metal content (wt%)	
	Au powder	Pt powder	Ag powder	Methyl cellulose	Ethyl cellulose	Water												
1	80	—	—	—	5	95	20	—	—	Atmospheric air	105	1	Atmospheric air	1450	10	95	100	
2	88	—	—	15	—	85	12	0.1	—							1050	100	
3	90	—	—	—	15	85	10	—	5							96	100	
4	92	—	—	—	30	70	8	0.05	2							98	100	
5	—	80	—	5	—	95	20	—	—							92	100	
6	—	90	—	15	—	85	10	5	—							94	100	
7	—	88	—	—	15	85	12	—	1							93	100	
8	—	93	—	—	30	70	7	0.5	0.5							95	100	
9	—	—	67	—	5	95	33	—	—							96	100	
10	—	—	78	—	15	85	22	—	4							920	96	100
11	—	—	82	15	—	85	18	0.2	—								98	100
12	—	—	84	—	30	70	16	1	10								98	100
13	80	—	—	—	5	90	20	—	—							1050	96	100
14	85	—	—	15	—	75	15	0.1	—								97	100
15	—	90	—	—	15	60	10	—	0.7								94	100
16	—	—	80	—	20	79	20	0.1	2							920	98	100

** denotes ethylene glycol.

Polysoap and di-n-butyl phthalate contents are the percentages with respect to the total amount of precious metal powder and binder.

Claims

1. A method for manufacturing a precious metal article consisting essentially of a solid-phase sintered product of a precious metal powder free of any binder, whereby the article assumes the colour tone of the precious metal, comprising preparing a moldable mixture consisting essentially of:



Table 2

	Blending composition (wt%)										Drying conditions			Solid-phase sintering conditions			Precious metal article	
	Precious metal powder			Binder(weight ratio)			Polysoap	Di-n-butyl phthalate	Atmosphere	Temp. (°C)	Time (hour)	Atmosphere	Temp. (°C)	Time (hour)	Theoretical density ratio (%)	Precious metal content (wt%)		
	Au powder	Pt powder	Ag powder	Methyl cellulose	Ethyl cellulose	Water												
Precious metal articles of the invention	1	80	—	—	—	5	95	20	—	—	—	—	—	—	—	95	100	
	2	88	—	—	15	—	85	12	0.1	—	—	—	1050	—	—	98	100	
	3	90	—	—	—	15	85	10	—	—	—	—	—	—	—	96	100	
	4	92	—	—	—	30	70	8	0.05	2	—	—	—	—	—	98	100	
	5	—	80	—	5	—	95	20	—	—	—	Atmos- pheric air	—	—	—	92	100	
	6	—	90	—	15	—	85	10	5	—	—	105	—	1450	10	94	100	
	7	—	88	—	—	15	85	12	—	1	—	—	—	—	—	93	100	
	8	—	93	—	—	30	70	7	0.5	0.5	—	—	—	—	—	95	100	
	9	—	—	67	—	5	95	33	—	—	—	—	—	—	—	96	100	
	10	—	—	78	—	15	85	22	—	4	—	—	—	920	—	96	100	
	11	—	—	82	15	—	85	18	0.2	—	—	—	—	—	—	98	100	
	12	—	—	84	—	30	70	16	1	10	—	—	—	—	—	98	100	
	13	80	—	—	—	5	90	20	—	—	—	—	1050	—	—	96	100	
	14	85	—	—	15	—	75	15	0.1	—	—	—	1050	—	—	97	100	
	15	—	90	—	—	15	60	10	—	0.7	—	—	1450	—	—	94	100	
	16	—	—	80	—	20	79	20	0.1	2	—	—	920	—	—	98	100	

** denotes ethylene glycol.

Polysoap and di-n-butyl phthalate contents are the percentages with respect to the total amount of precious metal powder and binder.

Claims

1. A method for manufacturing a precious metal article consisting essentially of a solid-phase sintered product of a precious metal powder free of any binder, whereby the article assumes the colour tone of the precious metal, comprising preparing a moldable mixture consisting essentially of:



50 to 90 % by weight of a precious metal powder;
0.8 to 8 % by weight of a water-soluble cellulose binder;
0.03 to 3 % by weight of a surface-active agent;
0.1 to 3 % by weight of an adhesion-preventing agent;

5 balance water and unavoidable impurities;
wherein said binder is removable by sintering, shaping said moldable mixture into a prescribed molded object and subjecting said molded object to solid-phase sintering operation to provide the precious metal article.

10 2. A method for manufacturing a precious metal article according to claim 1, further comprising preparing a base object removable by the sintering; said shaping step including extending said moldable mixture on said base object; said sintering step including sintering said molded object and said base object, whereby said base object is removed away during the sintering.

15 3. A method for manufacturing a precious metal article according to claim 2, wherein said base object is composed of a material combustible during said sintering.

4. A method for manufacturing a precious metal article according to claim 2, wherein said base object is formed of a material liquefiable during said sintering.

20 5. A method for manufacturing a precious metal article according to claim 2, wherein said base object is formed of a material vaporizable during said sintering.

25 6. A method for manufacturing a precious metal article according to any one of the claims 1 to 5, wherein said shaping step includes forming said moldable mixture into a plate and punching a prescribed part of said plate to provide said molded object of a prescribed shape.

30 7. A method for manufacturing a precious metal article according to any one of the claims 1 to 6, further comprising preparing at least two kinds of the moldable mixtures, said shaping step including forming one of said moldable mixtures into a plate and removing a prescribed portion of said plate to form a vacant region, and stuffing the other moldable mixture into said vacant region of said plate to provide said molded object.

35 8. A method for manufacturing a precious metal article according to any one of the claims 1 to 7, further comprising preparing at least two kinds of moldable mixtures which assume different colors by the sintering operation, blending said moldable mixtures to provide a blended moldable material, and forming said molded objects using said blended moldable material.

40 9. A method for manufacturing a precious metal article according to claim 8, further comprising subjecting a sintered product obtained in said sintering step to plastic working.

45 10. A method for manufacturing a precious metal article according to any one of the claims 1 to 9, further comprising causing a glass material to adhere to said molded object at a prescribed surface thereof, whereby when said sintering step is carried out, said glass material is melted and extended on the object.

50 11. A method for manufacturing a precious metal article according to any one of the claims 1 to 10, further comprising placing a jewel on said molded object, whereby when said sintering operation is completed, said jewel remains on the precious metal article.

55 12. A moldable mixture for use in the manufacturing method according to any one of the claims 1 to 11, comprising a precious metal powder and a binder, characterised in that it consists of:
50 to 90 % by weight of a precious metal powder;
0.8 to 8 % by weight of a water-soluble cellulose binder;
0.03 to 3 % by weight of a surface-active agent;
0.1 to 3 % by weight of an adhesion-preventing agent;
balance water and unavoidable impurities.



13. A moldable mixture according to claim 12, further containing ethylene glycol in an amount of no greater than 30 % by weight with respect to water.
14. A moldable mixture according to claim 12 or 13, wherein said precious metal powder has an average particle size of no greater than 200 μ m.
15. A moldable mixture according to any one of the claims 12 to 14, wherein said precious metal powder contains gold powder and powder of an alloy containing a metal selected from the group consisting of silver and copper.
16. A moldable mixture according to any one of the claims 12 to 15, wherein said gold powder is obtained by submerged-reduction method while said alloy powder is obtained by gas-atomizing method.
17. A moldable mixture according to claim 16, wherein said precious metal powder further contains a gas-atomized powder of an alloy of a metal selected from the group consisting of nickel, palladium, zinc, cobalt, beryllium, tin and indium.
18. A moldable mixture according to claim 15, wherein said precious metal powder contains gold powder, each individual particle of which having smaller protuberances adherent thereto.
19. A moldable mixture according to claim 18, wherein said gold powder has an average particle size of about 10 μ m.
20. A moldable mixture according to any one of the claims 12 to 19, wherein said binder is selected from the group consisting of methyl cellulose and ethyl cellulose, said surface-active agent being selected from the group consisting of polysoap and alkyl benzene sodium sulfonate, said adhesion-preventing agent being selected from the group consisting of higher organic, acid, higher organic ester, higher alcohol, higher polyhydric alcohol and higher ethers.
21. A method for producing a moldable mixture according to any one of the claims 12 to 20 comprising the steps of:
 preparing 50 to 90 % by weight of a precious metal powder;
 preparing 0.8 to 8 % by weight of a jelly-like cellulose binder by blending a cellulose with water and leaving for a prescribed period of time;
 blending said precious metal powder and said jelly-like cellulose binder together; and
 adding 0.03 to 3 % by weight of a surface-active agent and 0.1 to 3 % by weight of an adhesion-preventing agent.
22. A method according to claim 21, wherein said cellulose and water are blended at a ratio of cellulose to water of 5/95 to 30/70, and the binder formed is blended in an amount of 7 to 33 % by weight with respect to the total amount of the moldable mixture.
23. A method according to claim 22, further comprising adding ethylene glycol in an amount of no greater than 30 % by weight with respect to water.
24. A method according to claim 21, further comprising preparing gold powder by submerged-reduction method and an alloy powder by gas-atomizing method, and mixing said gold powder and alloy powder thus prepared to provide said precious metal powder.
25. A method according to claim 24, further comprising including a gas-atomizing alloy powder of a metal selected from the group consisting of nickel, palladium, zinc, cobalt, beryllium, tin and indium.

Patentansprüche

1. Verfahren zur Herstellung eines Edelmetallartikels, bestehend im wesentlichen aus einem Festphasengesinterten Produkt eines Edelmetallpulvers, frei von jeglichem Binder, wobei der Artikel den Farbton des Edelmetalls annimmt, umfassend die Herstellung einer formbaren Mischung, bestehend im wesentlichen aus:



- 50 bis 90 Gew.% eines Edelmetallpulvers;
 0,8 bis 8 Gew.% eines wasserlöslichen Zellulosebinders;
 0,03 bis 3 Gew.% eines oberflächenaktiven Mittels;
 0,1 bis 3 Gew.% eines Antihafmittels;
 Rest Wasser und unvermeidbare Verunreinigungen;
 worin der Binder durch Sintern entfernbar ist, Formen der formbaren Mischung zu einem bestimmten geformten Objekt und Unterwerfen des geformten Objekts einer Festphasensinterbehandlung unter Bereitstellung des Edelmetallartikels.
2. Verfahren zur Herstellung eines Edelmetallartikels nach Anspruch 1, das ferner die Herstellung eines Basisobjektes, das durch Sintern entfernbar ist, umfaßt;
 wobei der Formschrift das Ausbreiten der formbaren Mischung auf dem Basisobjekt umfaßt, der Sinterschrift das Sintern des geformten Objekts und des Basisobjekts umfaßt, wodurch das Basisobjekt während des Sinterns entfernt wird.
3. Verfahren zur Herstellung eines Edelmetallartikels nach Anspruch 2, worin das Basisobjekt aus einem während des Sinterns verbrennbaren Materials aufgebaut ist.
4. Verfahren zur Herstellung eines Edelmetallartikels nach Anspruch 2, worin das Basisobjekt aus einem während des Sinterns verflüssigbaren Materials gebildet ist.
5. Verfahren zur Herstellung eines Edelmetallartikels nach Anspruch 2, worin das Basisobjekt aus einem während des Sinterns vaporisierbaren Materials gebildet ist.
6. Verfahren zur Herstellung eines Edelmetallartikels nach einem der Ansprüche 1 bis 5, worin ein Formschrift das Formen der formbaren Mischung in eine Platte und Ausstechen eines bestimmten Teils der Platte unter Bereitstellung des geformten Objekts mit einer bestimmten Form umfaßt.
7. Verfahren zur Herstellung eines Edelmetallartikels nach einem der Ansprüche 1 bis 6, das ferner die Herstellung von mindestens zwei formbaren Mischungen umfaßt, wobei der Formungsschrift das Formen einer der formbaren Mischung in eine Platte und Entfernen eines bestimmten Teils der Platte unter Bildung eines freien Bereichs umfaßt, und Einfügen der anderen formbaren Mischung in die freie Region der Platte unter Bereitstellung des geformten Objekts.
8. Verfahren zur Herstellung eines Edelmetallartikels nach einem der Ansprüche 1 bis 7, was ferner die Herstellung von mindestens zwei Arten von formbaren Mischungen umfaßt, die verschiedene Farben annehmen, durch eine Sinterbehandlung, Vermischen der formbaren Mischung unter Bereitstellung des gemischten formbaren Materials und Formen der geformten Objekte unter Verwendung des vermischten formbaren Materials.
9. Verfahren zur Herstellung eines Edelmetallartikels nach Anspruch 8, das ferner das Unterwerfen eines gesinterten Produkts, das im Sinterschrift erhalten wird, einer plastischen Bearbeitung umfaßt.
10. Verfahren zur Herstellung eines Edelmetallartikels nach einem der Ansprüche 1 bis 9, das ferner das Anhaften von Glasmaterial auf dem geformten Objekt an einer bestimmten Oberfläche umfaßt, wobei das Glasmaterial schmilzt und sich über das Objekt ausbreitet, wenn der Sinterschrift durchgeführt wird.
11. Verfahren zur Herstellung eines Edelmetallartikels nach einem der Ansprüche 1 bis 10, das ferner das Aufbringen eines Edelsteins aus dem geformten Objekt umfaßt, wobei nach Abschluß der Sinteroperation der Edelstein auf dem Edelmetallartikel verbleibt.
12. Formbare Mischung zur Verwendung im Herstellungsverfahren gemäß einem der Ansprüche 1 bis 11, umfassend ein Edelmetallpulver und einen Binder, dadurch gekennzeichnet, daß er besteht aus
 50 bis 90 Gew.% eines Edelmetallpulvers;
 0,8 bis 8 Gew.% eines wasserlöslichen Zellulosebinders;
 0,03 bis 3 Gew.% eines oberflächenaktiven Mittels;
 0,1 bis 3 Gew.% eines Antihafmittels;



Rest Wasser und unvermeidbare Verunreinigungen.

13. Formbare Mischung nach Anspruch 12, die ferner Ethylenglycol in einer Menge von nicht größer als 30 Gew.%, bezogen auf Wasser, enthält.
14. Formbare Mischung nach Anspruch 12 oder 13, worin das Edelmetallpulver eine mittlere Partikelgröße von nicht größer als 200 µm hat.
15. Formbare Mischung nach einem der Ansprüche 12 bis 14, worin das Edelmetallpulver Goldpulver und Pulver einer Legierung, die ein Metall ausgewählt aus Silber und Kupfer enthält, umfaßt.
16. Formbare Mischung nach einem der Ansprüche 12 bis 15, worin das Goldpulver erhalten wird durch Untertauch-Reduktionsverfahren, wogegen das Legierungspulver durch ein Gas-Atomisierungsverfahren erhalten wird.
17. Formbare Mischung nach Anspruch 16, worin das Edelmetallpulver ferner ein Gas-atomisiertes Pulver einer Legierung eines Metalls enthält, ausgewählt aus Nickel, Palladium, Zink, Kobalt, Beryllium, Zinn und Indium.
18. Formbare Mischung nach Anspruch 15, worin das Edelmetallpulver Goldpulver enthält, wobei an jedem einzelnen Teilchen kleinere Protuberanzen anhaften.
19. Formbare Mischung nach Anspruch 18, worin das Goldpulver eine mittlere Partikelgröße von ca. 10 µm hat.
20. Formbare Mischung nach einem der Ansprüche 12 bis 19, worin der Binder ausgewählt ist aus Methylzellulose und Ethylzellulose, wobei das oberflächenaktive Mittel ausgewählt ist aus Polyseife und Alkylbenzolsulfonat, das Antihafmittel ausgewählt ist aus einer höheren organischen Säure, einem höheren organischen Ester, einem höheren Alkohol, einem höheren polybasischen Alkohol und höheren Ethern.
21. Verfahren zur Herstellung einer formbaren Mischung nach einem der Ansprüche 12 bis 20 umfassend die Schritte:
Herstellung ein von 50 bis 90 Gew.% eines Edelmetallpulvers;
Herstellung von 0,8 bis 8 Gew.% eines Gel-artigen Zellulosebinders durch Vermischen einer Zellulose mit Wasser und Stehenlassen für einen bestimmten Zeitraum;
Vermischen des Edelmetallpulvers des Gel-artigen Zellulosebinders miteinander; und
Zugeben von 0,03 bis 3 Gew.% eines oberflächenaktiven Mittels und 0,1 bis 3 Gew.% eines Antihafmittels.
22. Verfahren nach Anspruch 21, worin die Zellulose und das Wasser mit einem Verhältnis von Zellulose zu Wasser von 5/95 bis 30/70 vermischt werden, und der gebildete Binder in einer Menge von 7 bis 33 Gew.%, bezogen auf die Gesamtmenge der formbaren Mischung vermischt wird.
23. Verfahren nach Anspruch 22, das ferner die Zugabe von Ethylenglycol in einer Menge von nicht größer als 30 Gew.% bezüglich Wasser umfaßt.
24. Verfahren nach Anspruch 21, das ferner die Herstellung von Goldpulver durch Eintauch-Reduktionsverfahren und ein Legierungspulver durch ein Gas-Atomisierungsverfahren, und das Mischen des Goldpulvers und des so hergestellten Legierungspulvers unter Bereitstellung des Edelmetallpulvers umfaßt.
25. Verfahren nach Anspruch 24, das ferner die Aufnahme eines gasatomisierten Legierungspulvers eines Metalls, ausgewählt aus Nickel, Palladium, Zink, Kobalt, Beryllium, Zinn und Indium, umfaßt.

Revendications

1. Procédé de fabrication d'un article en métal précieux composé essentiellement d'un produit fritté à l'état solide d'une poudre de métal précieux exempte de tout liant, grâce auquel l'article prend la teinte



du métal précieux, comprenant les étapes consistant à préparer un mélange moulable composé essentiellement de :

- 50 à 90 % en poids d'une poudre de métal précieux,
- 0,8 à 8 % en poids d'un liant de cellulose soluble dans l'eau,
- 0,03 à 3 % en poids d'un agent tensio-actif,
- 0,1 à 3 % en poids d'un agent anti-adhésif,
- le reste étant de l'eau et des impuretés inévitables,

dans lequel ledit peut être éliminé par frittage, à former mélange moulable en un objet moulé prescrit et à soumettre ledit objet moulé à une opération de frittage à l'état solide pour procurer l'article en métal précieux.

2. Procédé de fabrication d'un article en métal précieux selon la revendication 1, comprenant en outre les étapes consistant à préparer un objet de base pouvant être éliminé par le frittage, ladite étape de mise en forme comprenant l'étape consistant à étendre ledit mélange moulable sur ledit objet de base, ladite étape de frittage comprenant le frittage dudit objet moulé et dudit objet de base, d'où il résulte que ledit objet de base est éliminé pendant le frittage.
3. Procédé de fabrication d'un article en métal précieux selon la revendication 2, dans lequel ledit objet de base est composé d'un matériau pouvant se consumer pendant ledit frittage.
4. Procédé de fabrication d'un article en métal précieux selon la revendication 2, dans lequel ledit objet de base est formé d'un matériau pouvant se liquéfier pendant ledit frittage.
5. Procédé de fabrication d'un article en métal précieux selon la revendication 2, dans lequel ledit objet de base est formé d'un matériau pouvant se vaporiser pendant ledit frittage.
6. Procédé de fabrication d'un article en métal précieux selon l'une quelconque des revendications 1 à 5, dans lequel ladite étape de mise en forme comprend les étapes consistant à former ledit mélange moulable en une plaque et à découper une partie prescrite de ladite plaque pour procurer ledit objet moulé d'une forme prescrite.
7. Procédé de fabrication d'un article en métal précieux selon l'une quelconque des revendications 1 à 6, comprenant en outre les étapes consistant à préparer au moins deux espèces des mélanges moulables, ladite étape de mise en forme comprenant les étapes consistant à former l'un desdits mélanges moulables en une plaque et à enlever une partie prescrite de ladite plaque afin de former une zone vacante, et à bourrer l'autre mélange moulable dans la zone vacante de ladite plaque afin de procurer ledit objet moulé.
8. Procédé de fabrication d'un article en métal précieux selon l'une quelconque des revendications 1 à 7, comprenant en outre les étapes consistant à préparer au moins deux espèces de mélanges moulables qui prennent des couleurs différentes par l'opération de frittage, à mélanger lesdits mélanges moulables afin de procurer un matériau moulable mélangé, et à former lesdits objets moulés en utilisant ledit matériau moulable mélangé.
9. Procédé de fabrication d'un article en métal précieux selon la revendication 8, comprenant en outre l'étape consistant à soumettre un produit fritté obtenu dans ladite étape de frittage à un travail plastique.
10. Procédé de fabrication d'un article en métal précieux selon l'une quelconque des revendications 1 à 9, comprenant en outre l'étape consistant à faire adhérer un matériau de verre audit objet moulé au niveau d'une surface prescrite de celui-ci, d'où il résulte que lorsque ladite étape de frittage est effectuée, ledit matériau de verre fond et s'étend sur l'objet.
11. Procédé de fabrication d'un article en métal précieux selon l'une quelconque des revendications 1 à 10, comprenant en outre l'étape consistant à placer une pierre précieuse sur ledit objet moulé, d'où il résulte que lorsque ladite opération de frittage est achevée, ladite pierre précieuse demeure sur l'article en métal précieux.



12. Mélange moulable destiné à être utilisé dans le procédé de fabrication selon l'une quelconque des revendications 1 à 11, comprenant une poudre de métal précieux et un liant, caractérisé en ce qu'il est composé de:
- 5 50 à 90 % en poids d'une poudre de métal précieux,
 - 0,8 à 8 % en poids d'un liant de cellulose soluble dans l'eau,
 - 0,03 à 3 % en poids d'un agent tensioactif,
 - 0,1 à 3 % en poids d'un agent anti-adhésif,
 - le reste étant de l'eau et des impuretés inévitables.
- 10 13. Mélange moulable selon la revendication 12, comprenant en outre de l'éthylèneglycol en une quantité ne dépassant pas 30 % en poids par rapport à l'eau.
14. Mélange moulable selon la revendication 12 ou 13, dans lequel ladite poudre de métal précieux présente une dimension particulaire moyenne ne dépassant pas 200 μm .
- 15 15. Mélange moulable selon l'une quelconque des revendications 12 à 14, dans lequel ladite poudre de métal précieux contient de la poudre d'or et de la poudre d'un alliage contenant un métal choisi parmi le groupe composé de l'argent et du cuivre.
- 20 16. Mélange moulable selon l'une quelconque des revendications 12 à 15, dans lequel ladite poudre d'or est obtenue par procédé de réduction en immersion tandis que ladite poudre d'alliage est obtenue par procédé d'atomisation sous gaz.
- 25 17. Mélange moulable selon la revendication 16, dans lequel ladite poudre de métal précieux contient en outre une poudre atomisée sous gaz d'un alliage d'un métal choisi parmi le groupe composé du nickel, du palladium, du zinc, du cobalt, du béryllium, de l'étain et de l'indium.
- 30 18. Mélange moulable selon la revendication 15, dans lequel ladite poudre de métal précieux contient de la poudre d'or, dont chaque particule individuelle comporte des protubérances plus petites qui lui adhèrent.
- 35 19. Mélange moulable selon la revendication 18, dans lequel ladite poudre d'or présente une dimension particulaire moyenne d'environ 10 μm .
- 40 20. Mélange moulable selon l'une quelconque des revendications 12 à 19, dans lequel ledit liant est choisi parmi le groupe composé de la méthylcellulose et de l'éthylcellulose, ledit agent tensio-actif étant choisi parmi le groupe composé de savon composé et de alkylbenzènesulfonate de sodium, ledit agent anti-adhésif étant choisi parmi le groupe composé d'un acide organique supérieur, d'un ester organique supérieur, d'un alcool supérieur, d'un alcool polyvalent supérieur et d'éthers-supérieurs.
- 45 21. Procédé de préparation d'un mélange moulable selon l'une quelconque des revendications 12 à 20, comprenant les étapes consistant à :
- préparer 50 à 90 % en poids d'une poudre de métal précieux,
 - préparer 0,8 à 8 % en poids d'un liant de cellulose sous forme de gelée en mélangeant une
 - 45 cellulose avec de l'eau et en laissant reposer pendant une durée prédéterminée,
 - mélanger ladite poudre de métal précieux et ledit liant de cellulose sous forme de gelée, et
 - ajouter 0,03 % à 3 % en poids d'un agent tensio-actif et 0,1 à 3 % en poids d'un agent anti-adhésif.
- 50 22. Procédé selon la revendication 21, dans lequel ladite cellulose et ladite eau sont mélangés dans un rapport entre la cellulose et l'eau de 5/95 à 30/70, et le liant formé est mélangé en une quantité de 7 à 33 % en poids par rapport à la quantité totale du mélange moulable.
- 55 23. Procédé selon la revendication 22, comprenant en outre l'étape consistant à ajouter de l'éthylèneglycol en une quantité ne dépassant pas 30 % en poids par rapport à l'eau.
24. Procédé selon la revendication 21, comprenant en outre l'étape consistant à préparer de la poudre d'or par un procédé de réduction en immersion et une poudre d'alliage par un procédé d'atomisation sous



gaz, et à mélanger ladite poudre d'or et ladite poudre a'alliage ainsi préparées pour procurer ladite poudre de métal précieux.

25. Procédé selon la revendication 24, comprenant en outre l'étape consistant à inclure une poudre d'alliage atomisée sous gaz d'un métal choisi parmi le groupe composé du nickel, du palladium, du zinc, du cobalt, du béryllium, de l'étain et de l'indium.

5

10

15

20

25

30

35

40

45

50

55