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(54) **METHOD FOR THE PRODUCTION OF A MOLDED BLANK FROM METAL POWDER**

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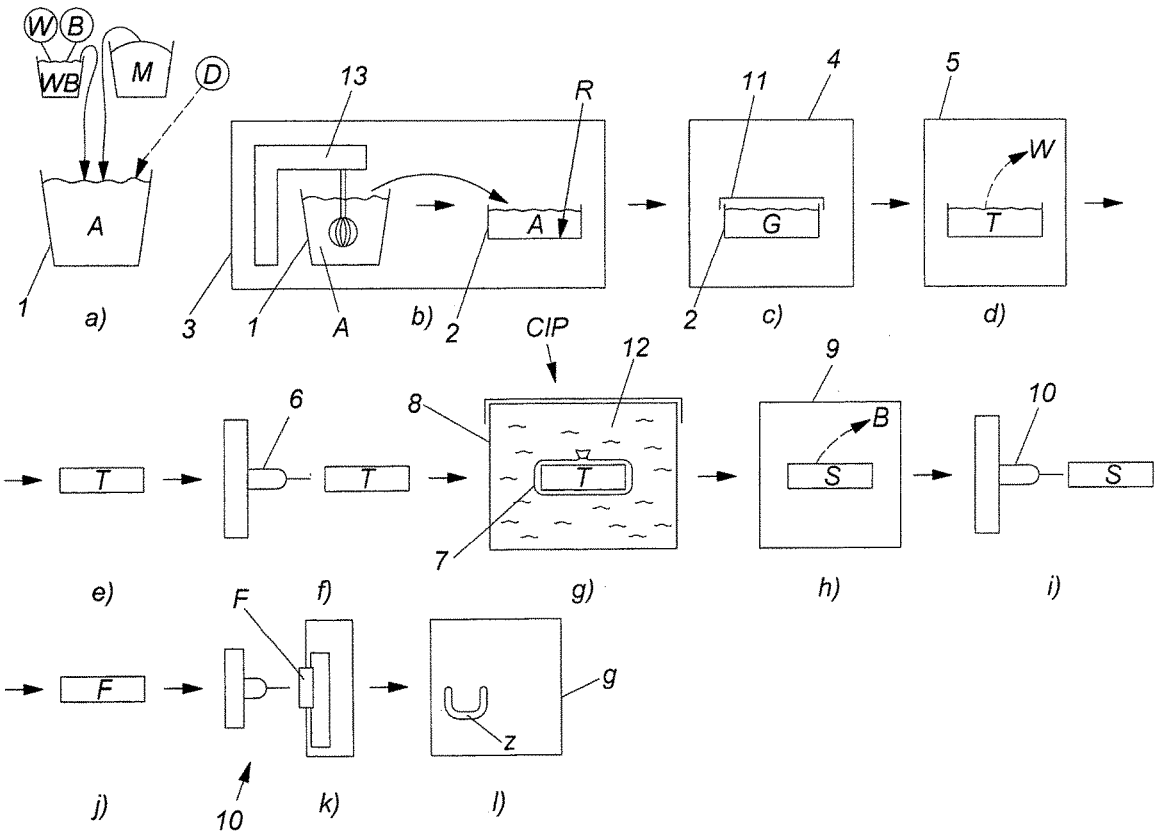
(57) **ABSTRACT**

Disclosed is a method for producing a molded blank from metal powder using a gel-casting process, wherein a starting mixture for the gel-based process is made by mixing the metal powder with a liquid and a binder, the starting mixture being thoroughly mixed in a vacuum.



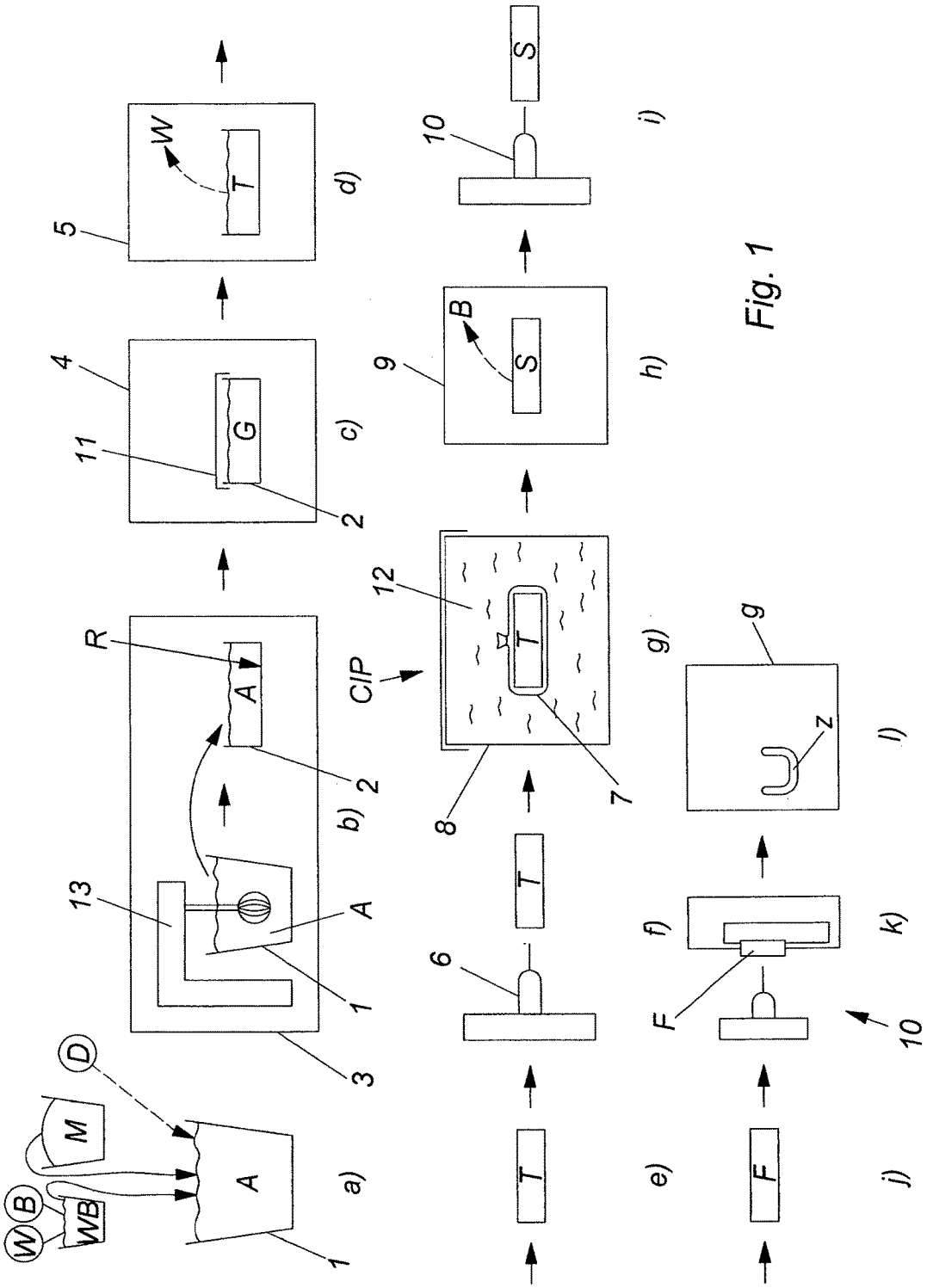


Fig. 1

Fig. 2

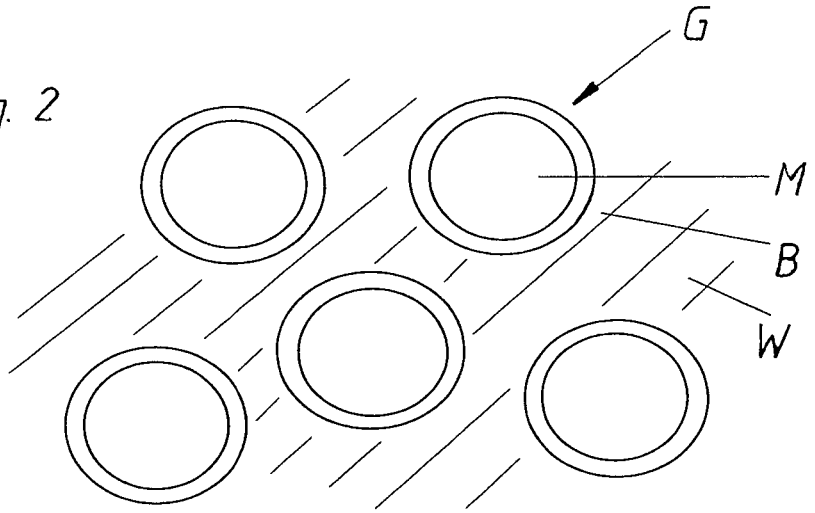


Fig. 3

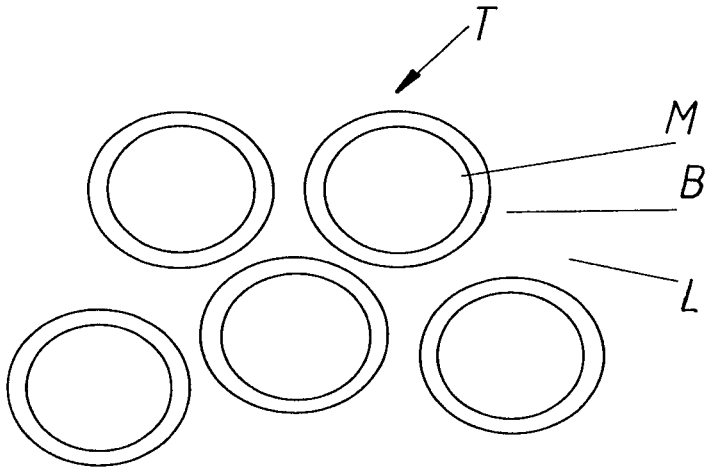
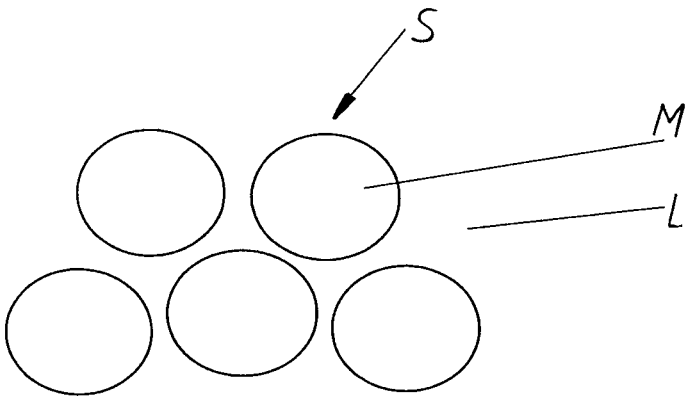


Fig.4



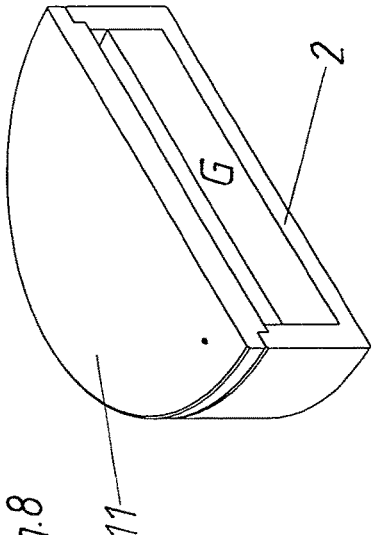


Fig.8

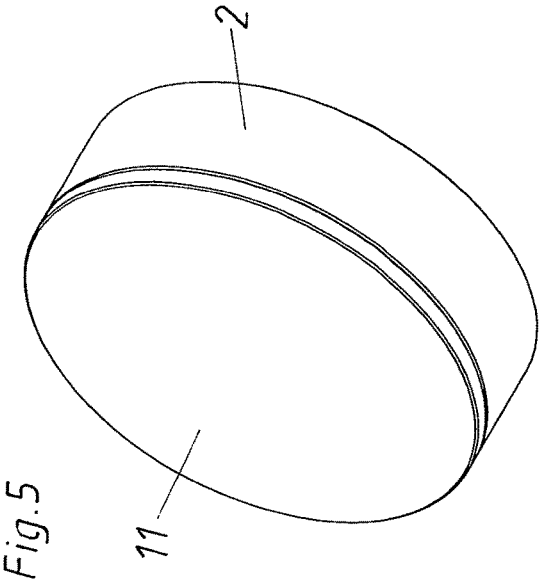


Fig.5

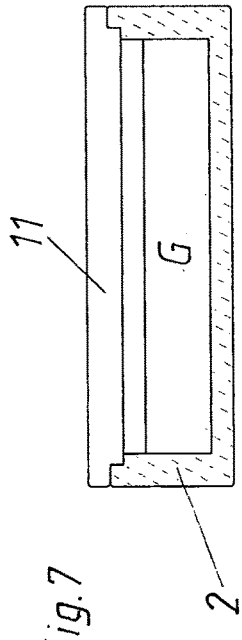


Fig.7

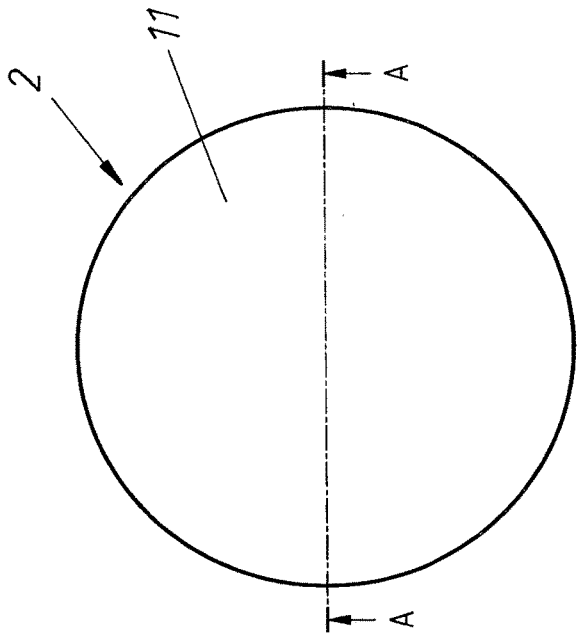


Fig.6

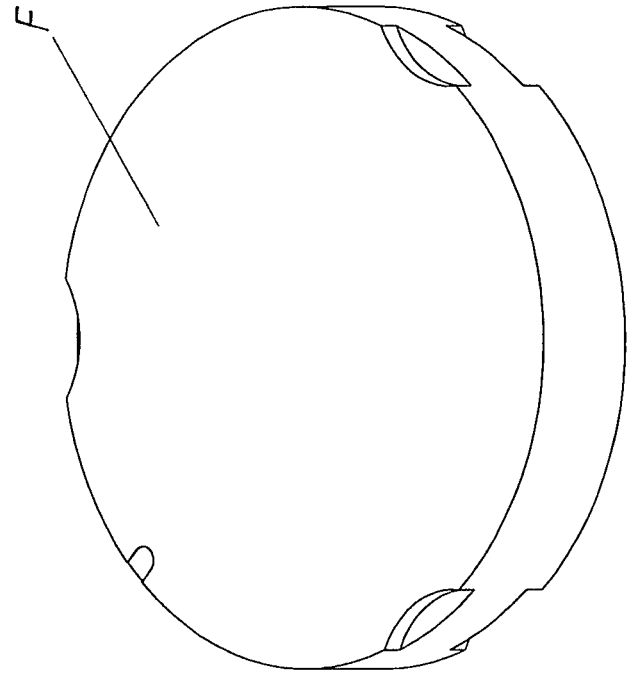


Fig 10

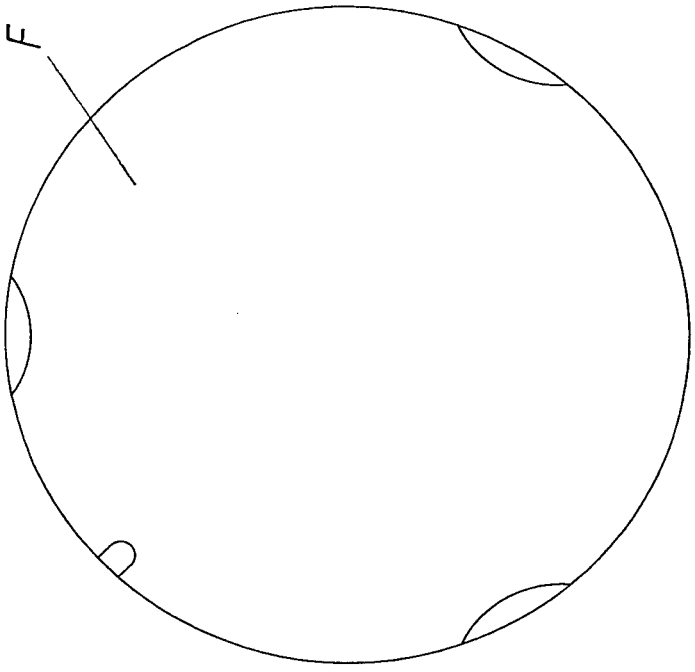


Fig.9

METHOD FOR THE PRODUCTION OF A MOLDED BLANK FROM METAL POWDER

[0001] The invention concerns a method for producing a molded blank from metal powder. Moreover, the invention concerns a molded blank produced with such a method as well as the use of the molded blank for producing a denture.

[0002] Non generic production methods for the production of any molded blanks made of ceramic or ceramic powder are already known. An example for a production method of a ceramic molded blank on the basis of a so-called gel-casting process is disclosed in the CN 202213028 U. Also the U.S. Pat. No. 6,354,836 B1 discloses such a possibility. The production of a ferroelectric ceramic blank is for example disclosed in the CN 101870581 A. A method for the production of ceramic grinding balls is disclosed in the CN 101857443 A. Also the EP 1 552 913 A1 discloses the production of a ceramic blank. Ink jet print heads produced on the basis of ceramic powder are disclosed in the U.S. Pat. No. 6,065,195. The production of a radome on the basis of a gel-casting process with ceramic powder is disclosed in the U.S. Pat. No. 6,083,452.

[0003] Processable metallic molded blanks produced in generic metal-based production methods are required in the most different industrial sectors. An example for this is the dental technology (production of dental prosthesis), in which in recent times—besides ceramic blanks—also molded blanks on the basis of metal are processed more frequently. In order to produce processable metallic molded blanks, there are already diverse production methods for many years.

[0004] Such a production methed is the so-called dry pressing. For this purpose metal powder and a binder without water is mixed and compressed to a green body under mechanic pressure (applied pressure). An example for such a production method is disclosed in the EP 2 450 003 A2. In this dry pressing it is disadvantageous that not arbitrary fine powders can be used, as a much higher pressing force has to be applied when having a more fine powder. Thereby, producing fine and smooth surfaces is difficult or can only be done in a very sophisticated manner.

[0005] In contrast, there is also the wet pressing. An example therefor is the so-called slip casting, where a metal powder is mixed with a liquid to a slip and is poured into a liquid-absorbing or absorbent mold (for example made of gypsum). Suspension liquid is drawn out of the slip by this mold till a mechanically stable blank is obtained, which blank can be subsequently milled and sintered oxygen-free. A corresponding method is described in the EP 2 470 113 B1. It is disadvantageous in this method that the sold parts are liquefying when contacting water, as there is still binder in the blanks. Moreover, there is a relative high shrinkage in the subsequently following sintering. Further, the molded blanks produced in such a manner have an inhomogeneous density distribution because of potentially emerged blow-holes or inclusions.

[0006] In the metal powder injection molding method also known form the prior art, it is disadvantageous that the mold blanks produced in this way are limited with a wall thickness of maximal 15 mm, especially as a used binder cannot escape anymore when having larger wall thicknesses.

[0007] Hence, the invention concerns a so-called gel-casting method in which a starting mixture for the gel-casting is made by mixing the metal powder with a liquid and a binder.

[0008] Examples for diverse methods of gel-casting are disclosed in the WO 2007/008828 A2, the CN 1594196 A and the U.S. Pat. No. 7,655,586 B1. Further information for gel-casting based on metal can be found in the articles, "Gelcasting of metal powders in nontoxic cellulose ethers system", Journal of materials processing technology 208 (2008), pages 457 to 462 and in "Colloidal Shaping of Alumina Ceramics by Thermally Induced Gelation of Methylcellulose", Journal of the American Society—Hareesh et al., Vol. 94, No. 3, pages 749 to 753.

[0009] It is disadvantageous in these known gel-casting methods that the produced molded blanks are not homogeneous, whereby the blank can have an uneven surface even after a mechanic machining. This inhomogeneity is not desired especially in high-precision and optically demanding dentures.

[0010] Therefore, the object of the present invention is to establish an improved method and an improved molded blank compared to the prior art. In particular, the disadvantages existing in the prior art should be removed. This means, the molded blank should be homogeneous as possible.

[0011] This is solved by a method with the features of claim **1**. Advantageous embodiments of the present invention are quoted in the sub-claims.

[0012] All details, advantages and implementation variants according to the sub-claims of the present invention are described more fully hereinafter by means of the specific description with reference to the embodiments illustrated in the drawings, in which:

[0013] FIG. **1** schematically shows the whole method for the production of a molded blank and a denture,

[0014] FIGS. **2** to **4** schematically show close-ups of the gel-solidified green body, the dried green body and the pre-sintering body,

[0015] FIGS. **5** to **8** show diverse views of the closed mold and

[0016] FIGS. **9** and **10** show two views of the completed molded blank.

[0017] The preferred method steps a to j for the production of a molded blank F are schematically depicted in FIG. **1** from top left to bottom right. The final machining steps k and l for the production of a denture Z out of the molded blank F are schematically depicted in the bottom middle.

[0018] In the method step a the binder B is blended with the liquid W in a container (for example in a bucket) to a liquid-binder mixture WB, before this liquid-binder mixture WB is blended with the metal powder M (also called dental metal) in a container **1** to build the starting mixture A. As appropriate, this blending can be effected under vacuum. Basically, in the method step a the mixing steps of the liquid W, the binder B and the metal powder M can be effected in a random order or simultaneous. Preferably, however, it is provided that the mixed liquid-water mixture WB is mixed with the metal powder M in a subsequent step. The mixing can be effected by a stirring device with a sufficiently high rotational speed, in order to prevent a lump formation.

[0019] Concerning the mixing relationships of liquid W to binder B it can be generally noted that the binder B is added to the liquid W at maximum till reaching the solubility limit. Preferably, however, it is provided that the relationship of the weight percentage of liquid W to binder B in the starting mixture A is between 95 to 5 and 99.9 to 0.1. If the proportion of binder B is higher than 5%, mostly—depend-

ing from the solubility limit—the binder B cannot any more be solved sufficiently in the liquid W. If the proportion of binder B, in contrast, is below 0.1%, no sufficient gelation can be reached in the gel-casting and, thus, no sufficient green strength can be reached any more. The proportion of Binder B is preferred between 1% by weight and 3% by weight. Particularly preferred this proportion of Binder B of the liquid-binder mixture WB is 2% by weight. In principle, alcohols can be used as liquid W. Advantageous water, in particular distilled water, is used as liquid. This water can have the temperature of tap water—therefore preferably between 8° C. and 18° C.

[0020] For the mixing relationship of the starting mixture A it is preferably provided that the relationship of the weight percentage of liquid W and binder B to metal powder M in the starting mixture A is between 5 to 95 and 20 to 80. The finer the used metal powder M the larger the surface and the more liquid W is necessary for wetting this surface. If the liquid proportion is below 5% by weight, the viscosity of the starting mixture A is too high. Thereby, the slip or the starting mixture A is not any more pourable, the air inclusions can hardly escape and a stirring is hardly or not any more possible. If the proportion of liquid W is above 20% by weight, the shrinkage in the later following drying is too high, the green density sinks (after a further processing) and the green strength can become too low. Preferably the liquid-binder mixture WB has a weight percentage between 7.5 and 15 of the starting mixture A. Particularly preferred this weight percentage is 10.

[0021] In order to improve the miscibility of the metal powder M with the liquid-binder mixture WB, a liquefying means, preferably a dispersant D (surface-active agent), is added or admixed to the entire starting mixture A, to the metal powder M or to the liquid-binder mixture WB. Thereby, the surface of the metal powder M is better moistened with the liquid W. Especially the surface tension of the liquid W is changed by the dispersant D. An organic alkali-free liquefying means can be used as the dispersant D. Exemplary the means with the product name DOLAPIX CE64 can be used as the dispersant D.

[0022] The subsequent method step b shows the thoroughly mixing of the starting mixture A and the pouring of this starting mixture A into a mold **2**. According to the invention at least the thoroughly mixing is effected under vacuum. Also the pouring is preferably effected under vacuum.

[0023] In gel-casting the starting mixture A is relative highly viscous. Air bubbles developing during or by the mixing can badly escape from this highly viscous starting mixture A, whereby in the end an inhomogeneous molded blank F would emerge. According to the invention, thus, a thoroughly mixing of the starting mixture A is effected under vacuum. Thereby, air inclusions in the starting mixture A are largely avoided. Especially the larger air bubbles can escape. Smaller air bubbles hardly mar. Air bubbles can remain narrow below the faster hardening surface, which air bubbles later, however, can be removed by cutting without problems.

[0024] Particularly preferred it is provided in method step b that the thoroughly mixing under vacuum is effected in a vacuum chamber **3**, wherein a low pressure, preferably between 25 and 40 millibar, prevails in the vacuum chamber **3**. Particularly preferred a low pressure of 30 millibar at 840 m above sea level is created in the vacuum chamber **3**. When having a low pressure of 23 to 24 millibar, the cold water in the vacuum would already start to boil at this sea level. Of course, an intense thoroughly mixing or turbulence of the starting mixture can already be effected also before the thoroughly mixing effected under vacuum. Advantageous, this is effected, however, only or mainly under vacuum, as thereby the air inclusions can better escape. The thoroughly mixing is preferably effected by a stirring device **13** at least partly arranged in the vacuum chamber **3**. The thoroughly mixing, however, can also be caused by shaking or by vibrations.

[0025] In the method step b the good through-mixed starting mixture is poured in into a mold **2** subsequently. This pouring in is preferably effected under vacuum. Thereto, a mechanic device (not shown) for pouring in of the starting mixture A into the mold **2** can be arranged in the vacuum chamber **3**. This mold **2** is preferably made of metal. The geometry of the mold **2** is per se arbitrary. Preferably, the mold **2** is bowl-shaped and forms a circular-cylindric internal space or cavity. As suggested in method step b, the mold **2** can be coated with a release agent R before the introducing of the starting mixture A, so that as possible no material adheres on the mold surface. This release agent R can be silicone based. It should not be water-soluble. As a specific example for such a release agent R ACMOSIL 36-6032 H can be quoted.

[0026] For the described gel-casting method a powder based on cobalt, chrome, molybdenum, wolfram, carbide, beryllium, stainless steel, titanium, aluminum, copper, tin and similar metals or mixtures thereof can be used as metal powder M. Particularly preferred a chrome-cobalt alloy is used as metal powder M. Particularly preferred alloys can be: chrome-cobalt-molybdenum, chrome-cobalt-wolfram and wolfram-carbide. The metal powder M can preferably have a grain size between 3 μm and 50 μm.

[0027] According to method step c the starting mixture A is warmed after the mixing of liquid W, binder B and metal powder M to the starting mixture A, the thoroughly mixing of the starting mixture A under vacuum and the pouring in of this thoroughly mixed starting mixture A into the mold **2**, whereby the gelation in the starting mixture A starts and the starting mixture A is solidified to a gel-solidified green body G. Basically, the temperature for the gel-casting has to be located above the gelation range of the binder B and below the boiling temperature of the liquid W. This warming is preferably effected in a heating cabinet **4**. Particularly preferred the starting mixture A for the gelation is warmed in the heating cabinet **4** for 20 minutes to 70 minutes, preferably for 35 minutes to 55 minutes, to a temperature between 50° C. and 95° C., preferably to 60° C. to 85° C. The ideal period for a good and homogeneous gelation strongly depends on the part geometry, on the wall thicknesses, and so on. The larger the temperature difference between the gelation temperature and the temperature prevailing in the heating cabinet **4**, the faster the gelation. Preferably there is a temperature of 80° C. in the heating cabinet **4** during the gelation. For an ideal product the gelation in the starting mixture A should be effected as possible without fluid loss. Therefore it is preferably provided that the mold **2** is closed, preferably airtight, with a cover **11** (thereto it should be referred to FIGS. **5** to **8**). Thereby, a too early start of the drying is avoided. Thus, almost no liquid extraction is effected. At most, a small amount of liquid W condenses on the cover **11**. Correspondingly, a schematic close-up of the

gel-solidified green body G is shown in FIG. **2**. Accordingly, the grains of the metal powder M are enveloped by the binder B. The remaining room is filled with the liquid W.

[0028] In a first possible gel-casting technique a monomer with a crosslinker, which start the polymerization (gelation), can be used a binder B. At that, the binder B can have a proportion of up to 15% by weight on the liquid-binder mixture WB. In this technique the solidification can be poorly controlled, as a reaction with the monomer already starts with the addition of the crosslinker. Thus, the gelation can already start when pouring in, whereby pouring errors and irregularities can occur. Also, some monomers are poisonous and cannot be used because of this. Moreover, the drying is more difficult in gel-casting with monomers, as the gelation has to be effected longer (several days up to weeks), because otherwise cracks can easily emerge. This is due to the fact that the surface is quickly hardening, whereas the core stays soft long.

[0029] In a preferred embodiment these disadvantages are eliminated in that cellulose, preferably methylcellulose, is used as binder B. No cracks occur when using cellulose as binder B. In the gel-casting the starting mixture A is not so brittle. The cellulose solidifies starting from a temperature of about 50° C. to 60° C., whereby the gelation eventuates. The gel strength has not to be depended on the gelation temperature. The gelation temperature and the gel strength do mainly depend on the used binder B or on the used cellulose. At that, the binder B consists, preferably to 100%, of methylcellulose.

[0030] The weight of the gel-solidified green body G can be between 0.5 kg and 5 kg, preferably between 1 kg and 1.5 kg. However, this can, of course, strongly vary depending on the form and size of the piece to be produced at the end. In the dental technology pieces or molded blanks F with the mentioned weight range are usual. In principle, thus, pieces of any size and weight can be produced.

[0031] Next the method step d is carried out, in which the gel-solidified green body G is dried in a drying cabinet **5** for 10 to 20 hours at a temperature between 50° C. and 95° C. to a dried green body T. Basically, also the heating cabinet **4** can be used as drying cabinet **5**. The drying process can be effected in that the cover **11** is removed after the gelation, whereby the mold **2** is opened. Theoretically, a demolding can immediately be effected, as the gel-solidified green body G has already a sufficient solidity. However, it is sufficient for the drying process that the mold **2** is only opened so that an evaporation of the liquid W can start as graphically illustrated in method step d according to FIG. **1**. In this drying process it is favorable for the development of the material, when the temperature in the drying cabinet **5** remains below the boiling point of the liquid W. The temperature may not fall under no circumstances below the gelation range, as otherwise the liquefying of the gel would start again. Therefore, a temperature of 90° C. is ideal during drying of the gel-solidified green body G to the dried green body T. In the case of this temperature the advantage of a fast drying is given, but the temperature is still sufficiently far away from the boiling point of the water. By this drying process practical the whole liquid W—except for the residual moisture because of the humidity—is removed from the gel-solidified green body G. A close-up of the dried green body T is schematically shown in FIG. **3**, from which follows that the binder B surrounds or moistens the grains of the metal powder M. The room between the single grains, however, is filled with air L due to the drying.

[0032] The method step e is subsequently conducted, in which the dried green body T is removed from the mold **2**. The green body G and T respectively are preferably disk-shaped. The geometry, however, can also be quadratic. Also more complex forms are possible. Also, the geometry can already be adapted to the piece being produced. For example, the green body G and T respectively can be horseshoe-shaped in order to later produce dental bridges and dental bars respectively.

[0033] According to the subsequent method step f the surface of the dried green body T is machined by a machining device **6** after the demolding. Open pores or unevenness emerged due to bubbles are removed or ablated through this machining. Potentially emerged defects are removed. If the surface is smooth enough, this step does not have to be carried out. However, the surface should be so smooth that in the subsequent method step g in the CIP process no damage of the packaging **7** for example consisting of nylon occurs. This is the essential reason for the method step f.

[0034] Thus, it has already been referred to the next method step g. According to this it is provided that the dried green body T is compressed in a cold isostatic pressing process (CIP procedure). In this process, the dried green body T is first put into a watertight packaging **7**. No compressing could be effected if liquid **12** or water would penetrate. Rather, the actually dried green body T would partly liquefy or would be filled with liquid W. Moreover, a compressing is not possible if water would enter, as certainly only the air-filled cavities produced by the drying can be compressed. The advantage of this CIP procedure is that there is small shrinkage in the final end sintering of the molded blank F. Concretely, the dried green body T arranged in the watertight packaging **7** is therefore put into a steel or pressure vessel **8** filled with liquid. This pressure vessel **8** is subsequently closed. Air can escape via a valve when the pressure vessel **8** is filled to the top with the liquid **12** (water). Then a high-pressure pump is switched on and the pressure build-up in the pressure vessel **8** is effected. The pressure has to be chosen so high that the binder B in the dried green body T is broken and, thus, a compression takes place. Preferably the CI P procedure is conducted at a pressure of at least 1000 bar, preferably at 2000 to 5000 bar, for at least 10 seconds, preferably for 20 to 40 seconds. Concretely, the cold-isostatic pressing is effected with a pressure of 4500 bar. This method step g especially serves for the post-compression. The dried green body T thereby reaches a green strength of about 6 kg/I. This fully depends, however, on the pressure and on the characteristics which are desired. The theoretical density of a preferred material is at 8.2 kg/I. In the case of CIP procedures with 4500 bar a density of about 6.3 kg/I is reached. At least a density of 50% of the theoretical density should be reached. In the preferred choice of material a density of about 5 kg/I is already reached before the CI P procedure. The finer the used metal powder M, the lower the density, as more water ought to be used, whereby more hollow areas would exist. Finer powder, however, contrarily leads again to a finer surface of the produced molded blank F, as a mill indeed always loosens entire grains of metal powder from the surface and does not split them.

[0035] After the cold-isostatic pressing the pressure vessel **8** is opened, the packaging **7** together with the dried green

body T is removed from the pressure vessel **8** and the dried green body T in turn is removed from the packaging **7**.

[0036] Afterwards the method step h is effected. According to that the dried green body T is sintered, preferably oxygen-free, in a sintering oven **9** to a pre-sintering body S. This process or method step h can be divided into a debindering and into a pre-sintering.

[0037] In the in the event of debindering it is preferably provided that the temperature in the sintering oven **9** rises in about 10 to 20 hours to 400° C. to 550° C. Initially a slow heating is effected when debindering, so that the binder B has enough time to escape (schematically shown in FIG. **1**) or to burn. By a slow ramp-up of the temperature onto 120° C. up to 500° C.—possibly with a holding time or a heating rate adapted to the binder system—already a good part of the binder B escapes. In the case of certain binders B and certain temperature, the pressure in the piece could rise too fast, wherefore short breaks in the increase in temperature can be provided. This means, no continuous increase in temperature has to be effected. This debindering lasts for about 15 hours in total. In debindering a temperature increase rate of about 1° C. per minute on average can be conducted in the sintering oven **9**. Finally, there is a holding time of about one hour at about 500° C.

[0038] At the beginning of the subsequent pre-sintering there is preferably a temperature increase rate of 2° C. per minute from 500° C. up to the desired end temperature. Then the temperature in the sintering oven **9** remains for 25 to 180 minutes in a range between 650° C. and 800° C. The temperature depends on the desired hardness, wherein it is preferably pre-sintered at about 730° C. Preferably this temperature in the sintering oven **9** is kept constantly for about 40 minutes. This especially serves therefore, that in the case of a multitude of dried green bodies T arranged in the sintering oven **9** all undergo the same pre-sintering.

[0039] By this method step h the dried green body T becomes the pre-sintering body S. Correspondingly, in FIG. **4** a close-up of the pre-sintering body S is schematically illustrated, according to which the binder B is escaped and the pre-sintering body S substantially only consists of the grains of metal powder M and the air L located in between. Also the compressed arrangement of the single grains of the metal powder M is visible.

[0040] For the basic procedure of this method it shall be quoted that virtually all specifications are very variable. Especially the respective values or parameters can be very different depending on the used materials.

[0041] Finally the method step i is effected, according to which the pre-sintering body S is machined in a machining device, preferably in a CNC milling device **10** or in a CAD-CAM machine. Thereby the pre-sintering body S becomes the molded blank F illustrated in method step j. Thus, a cutting manipulation into the final shape of the blank is effected, just as this blank is then sold. The specific geometry of this molded blank F is shown in the FIGS. **9** and **10**. The advantage of these molded blanks F compared to other blanks is the relative high strength. Moreover, these molded blanks F can also come into contact with water without problems. Further, the molded blanks F can be produced with a relative high wall thickness (up to 40 mm), as the binder B can still escape well in the case of these wall thicknesses. Further, in subsequent machining steps there is a lower shrinkage as compared to other production methods

[0042] Hence, protection is also sought for a molded blank F which is produced in a method according to the invention.

[0043] The production of a denture Z according to the method steps k and l follows the production method of the molded blank F according to the method steps a to j. This production of a denture Z can be effected directly at the customer or also, however, at the producer of the molded blanks. According to this a dental work piece (denture Z) can be worked out of the molded blank F individually by a CNC machine or by a CAD-CAM milling device. At the end, in method step l this denture Z is then again put into a sintering oven **9** and there, preferably oxygen-free, end sintered or densely sintered, whereby the denture Z gets the ultimate density and strength.

[0044] Correspondingly, protection is also sought for the use of a molded blank F produced in a method according to the invention for the production of a denture Z.

[0045] Of course, not all of the method steps from a to j for the production of the molded blank F have to be effected. Also the order as presented in FIG. **1** does not have to be followed. It is, however, especially important that the method steps b, c, d and h are effected, so that there is the forming of the molded blank F ensuing from the starting materials metal powder M, liquid W, and binder B via the mixing of the starting mixture A, the solidification to the gel-solidified green body G, the drying to the dried green body T right up to the debindering and pre-sintering to the pre-sintering body S.

1. A method for producing a molded blank from metal powder using a gel-casting process, wherein a starting mixture for the gel-casting process is made by mixing the metal powder with a liquid and a binder, wherein the starting mixture is thoroughly mixed in a vacuum.

2. The method according to claim **1**, wherein the relationship of the weight percentage of liquid to binder in the starting mixture is between 95 to 5 and 99.9 to 0.1.

3. The method according to claim **1**, wherein the relationship of the weight percentage of liquid and binder to metal powder in the starting mixture is between 5 to 95 and 20 to 80.

4. The method according to claim **1**, wherein the binder is blended with the liquid to a liquid-binder mixture before this liquid-binder mixture is blended with the metal powder.

5. The method according to claim **1**, wherein metal powder is used which is based on cobalt, chrome, molybdenum, wolfram, carbide, beryllium, stainless steel, titanium, aluminum, copper, tin or mixtures thereof.

6. The method according to claim **1**, wherein, preferably distilled, water is used as liquid.

7. The method according to claim **1**, wherein the binder contains cellulose, preferably methyl cellulose.

8. The method according to claim **1**, wherein a chemical auxiliary means for the mixing, preferably a dispersant, is admixed to the starting mixture.

9. The method according to claim **1**, wherein the thoroughly mixing in a vacuum is effected in a vacuum chamber, wherein a low pressure, preferably between 25 and 40 millibar, prevails in the vacuum chamber.

10. The method according to claim **1**, wherein the starting mixture thoroughly mixed in a vacuum is poured, preferably in a vacuum, into a mold.

11. The method according to claim **10**, wherein the mold is treated with a release agent before the starting mixture is poured into the mold.

12. The method according to claim **1**, wherein the starting mixture, preferably located in the mold closed with a cover, is warmed, preferably in a heating cabinet, whereby the gelation starts in the starting mixture and the starting mixture is solidified to a gel-solidified green body.

13. The method according to claim **12**, wherein for the gelation the starting mixture is warmed in the heating cabinet for 20 minutes to 70 minutes, preferably for 35 minutes to 55 minutes, to a temperature between 50° C. and 95° C., preferably to 60° C. to 85° C.

14. The method according to claim **12**, wherein the gel-solidified green body, preferably located in an opened mold, is dried to a dried green body in a drying cabinet for 10 to 20 hours at a temperature between 50° C. and 95° C.

15. The method according to claim **12**, wherein the gel-solidified green body or the dried green body is taken out of the mold.

16. The method according to claim **15**, wherein after the demolding the surface of the dried green body is machined by a machining device.

17. The method according to claim **12**, wherein the dried green body is compressed in a cold isostatic pressing process.

18. The method according to claim **17**, wherein the cold isostatic pressing process of the dried green body arranged in a watertight packaging is carried out in pressure vessel filled with a liquid at a pressure of at least 1000 bar, preferably at 2000 to 5000 bar, for at least 10 seconds, preferably for 20 to 40 seconds.

19. The method according to claim **12**, wherein the dried green body is debinded and sintered in a sintering oven to a pre-sintering body.

20. The method according to claim **19**, wherein in the event of sintering of the dried green body in the sintering oven a debinding is initially effected, in which the temperature in the sintering oven increases in about 10 to 20 hours to 400° C. to 550° C.

21. The method according to claim **19**, wherein after the debinding a pre-sintering of the dried green body to a pre-sintering body is carried out, in which the temperature in the sintering oven remains for 25 to 180 minutes in a range between 650° C. and 900° C.

22. The method according to claim **19**, wherein in a machining device, preferably in a CNC milling device, the pre-sintering bode is machined to the molded blank.

23. A molded blank produced in a method according to claim **1**.

24. Use of the molded blank according to claim **23** for the production of a denture.

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