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(54) PROCESS FOR THE PRODUCTION OF COIN BLANKS

VERFAHREN ZUR HERSTELLUNG VON MÜNZROHLINGEN

PROCEDE DE FABRICATION D'EBAUCHES POUR PIECES DE MONNAIE

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Description

[0001] This invention relates to a process for the production of coin blanks and in particular to the production of chromised coin blanks.

[0002] Stainless steel is used for coinage in several countries of the world. Whilst it provides the coin blank with an acceptable corrosion resistance for this application, the use of this material suffers from several disadvantages. Firstly, is a relatively expensive material. Secondly, it is difficult to strike without causing excessive die wear. Dies are expensive and contribute a significant cost to the overall cost of the struck coinage. Thirdly, it is difficult to achieve good definition on the struck coin and hence designs on stainless steel coin blanks tend to lack detail.

[0003] One alternative to stainless steel coin blanks is to use mild steel coin blanks which have been electroplated with nickel. However, there are commercial disadvantages in using this metal as well as environmental problems associated with the disposal of the spent electroplating solutions.

[0004] It has been established in the past that chromised steel is a successful alternative to stainless steel. There are several advantages to making coinage from chromised steel. There is an economic benefit of only having the chromium at the surface (typically 20-50 μm) rather than through the complete section of the coin blank as would be the case with stainless steel. The chromising process fully anneals the substrate steel hence the blank can be struck without the high wear on the dies that is typically seen when striking stainless steel. The chromised layer can be readily finished by mechanical means to a satisfactory appearance when the coin is in the blank form. The softness of the base material also allows intricate patterns to be applied to the coin blank. This is not the case when striking stainless steel where the designs have to be simple.

[0005] A common method of chromising steel is to pack the components to be chromised into a retort with a chromising compound. A suitable retort is charged with a chromising compound which contains the following ingredients: chromium metal powder, a diluent, such as titania, alumina or magnesia, and an energiser which is typically an ammonium halide. The components to be chromised are packed into this compound in layers. The components must be surrounded by a sufficient amount of the chromising compound for a satisfactory coating to be applied to the components and so that the individual components do not touch one another or the wall of the retort. An appropriate atmosphere is provided inside the retort to ensure that the chemical reactions proceed in the desired manner. The retort is then loaded into a furnace and taken to an elevated temperature, typically 1100°C, but not restricted to this temperature. This produces an atmosphere of chromium halide by the reaction of the ammonium halide and the chromium source material which then comes into contact with the component

to be coated. When the base material is a low-carbon steel the chromium deposits on the surface to form a solid solution alloy of iron and chromium. Typically this layer will have 20-45 wt% of chromium at its surface and will be about 25-125 μm in depth. This will only be the case if the steel is substantially free of carbon. The presence of greater than 0.05 wt% of carbon will tend to result in the formation of a layer of chromium-iron carbide on the surface of the solid solution coating. The components are held at the above temperature for typically 6-18 hours depending on the size of the retort. After soaking for this time at this temperature the retorts are removed from the furnace and allowed to cool to ambient temperature. Such a process is known from GB-A-764779.

[0006] However, this standard process has several disadvantages for the chromising of coin blanks. In particular the chromising of coin blanks in large quantities is not practical since hand packing the coin blanks into the chromising powder is labour intensive and not economically viable. One solution which has been proposed is the use of robotic packing although this too is problematic since careful control is needed to avoid coin blanks coming into contact with one another in the retort. Also the distortion that occurs to the retorts during continued firing renders the use of robotics difficult as the robot must be able to detect different shapes for individual retorts. In practice this is almost impossible without complicated and expensive control equipment.

[0007] There is therefore a requirement for an alternative, less costly way to produce coins of this type.

[0008] Accordingly, the present invention provides a process for applying a diffusion coating to steel coin blanks according to claim 1 comprising the steps of (i) charging a metallising reactor with a plurality of coin blanks and a chromising compound comprising ferro-chromium granules and an energiser, (ii) heating the chromising compound to generate a chromising vapour for deposition on to the coin blanks, and (iii) removing the coin blanks from the reactor, wherein the reactor is rotating at a rate of 0.5-50 rpm.

[0009] This process allows the efficient diffusion coating of metal coin blanks with chromium vapour without the associated disadvantages of previous processes.

[0010] The present invention will now be described with reference to the accompanying drawings, in which:

Fig. 1 shows a reactor for use in the present invention in (a) side elevation, (b) end elevation and (c) plan view;

Fig. 2 is a graph showing the concentration of chromium and iron in a steel coin blank coated using the process of the present invention;

Fig. 3 shows a metallographic section of a steel coin blank coated using the process of the present invention; and

Fig. 4 shows the distribution of the chromised layer around a steel coin blank coated using the process of the present invention.

[0011] This invention relates to a successful method of overcoming the disadvantages of using the conventional method of pack chromising for this particular product. Use is made of a rotary furnace into which the coin blanks may be introduced. Fig 1 shows a suitable rotary furnace for use with the present invention in (a) side elevation, (b) end elevation and (c) plan view. Fig 1 shows the reactor 1 contained within a furnace 2. The furnace 2 typically employs a gas burner, but an electrical resistance heater or induction heater may also be used. A motor 3 is attached to the reactor to rotate the furnace. The furnace is typically rotated at a rate of 2 rpm (revolutions per minute) but other speeds of rotation may be used. The rotation must not be too slow in order to prevent the coin blanks adhering to one another. The minimum speed of rotation is 0.5 rpm, preferably 1 rpm and most preferably 2 rpm. Also, the rotation must not be too fast to avoid damaging the coin blanks and prevent the rotating furnace becoming a hazard. The maximum speed of rotation is preferably 10 rpm, more preferably 20 rpm, more preferably 25 rpm and most preferably 50 rpm.

[0012] In the chromising process, a volatile chromium compound, usually a chromium halide, is generated in situ by heating a chromising compound comprising ferrochromium granules in the presence of an energiser and a refractory powder. The use of powdered chromium or ferrochromium as the source material proved unsatisfactory as particulate adhesion occurs during chromising which proved almost impossible to remove. Also the use of chromium in the form of granules was also unsuccessful as during the chromising since the chromium produced shards that then attached themselves strongly to the coin blanks. The use of ferrochromium granules proved successful as in this form the metallic is more ductile and is less likely to splinter during the processing. The ferrochromium granules may be any size provided they are sufficiently large to prevent particulate adhesion to the coin blanks. Preferably they are 2-8 mm, most preferably 4-6 mm in diameter.

[0013] The ferrochromium granules typically contain 40-80 wt% chromium, 0.05-2.5 wt% silicon and 0.025-0.25 wt% carbon, the balance being iron and inevitable impurities.

[0014] The energizer used for the chromising process generally contains a halide element such as bromide, chloride or fluoride. The preferred halides are of sodium, potassium and ammonium, and ammonium chloride is particularly preferred.

[0015] In some cases it was noticed that after chromising the coin blanks were stuck together due presumably to diffusion bonding. To eliminate this phenomenon, a refractory powder is added. The refractory powder is preferably Al_2O_3 (alumina), TiO_2 (titania), MgO or Cr_2O_3 . The most preferred refractory powder is alumina.

[0016] The chromising compound preferably comprises 15-90 wt%, more preferably 50-80 wt%, of ferrochromium granules and 0.1-10 wt% %, more preferably 1-5 wt%, of an energiser, the balance being made up by the

refractory powder which should be present at at least 1 wt%, more preferably at least 5 wt%, more preferably at least 10 wt% and most preferably at least 15 wt%.

[0017] The coin blanks are composed of steel, low-carbon steel having less than 0.25 wt% carbon. The steel is preferably substantially free of carbon, i.e. sufficiently low in carbon to avoid the formation of chromium carbide on the surface of the coin blank. In addition, an interstitial free (IF) steel may be used, that is a low-carbon steel which contains other metals which are able to bind to the carbon present in the steel to form carbides. Such strong carbide formers are known in the art and include titanium, niobium, tungsten, vanadium tantalum, chromium and molybdenum. These metals in the steel can chemically bind to the interstitial carbon which therefore reduces any interaction between this carbon and the diffusing chromium thereby avoiding the formation of chromium carbides.

[0018] The formation of chromium carbides in the coating should be avoided for two important reasons. Firstly, it is a hard and wear-resistant material and consequently if present in the coating (either at the surface or within the coating) causes excessive die wear when coin blanks are struck. Secondly, chromium carbide has a dull grey appearance which would reduce the aesthetic properties of the chromised blank after finishing. The use of chromised blank in titanium-stabilised steel (or any other carbide former-stabilised steel) has commercial benefits also as they can be produced more cheaply than stainless steel and the process of production does not have the environmental problems of producing blanks electroplated with nickel. The materials used to apply the chromised layer are all reusable whereas the spent electroplating solutions must be suitably treated for disposal.

[0019] An example of a suitable steel for use as a coin blank is composed of:

C	0.001-0.025 wt%
Mn	0.05-0.35 wt%
P	0.005-0.05 wt%
S	0.005-0.05 wt%
Si	0.004-0.1 wt%
N	0.002-0.03 wt%
Al	0.01-0.25 wt%
Ti	0.004-0.1 wt%
Nb	0.01-0.25 wt%
Fe	balance (the iron will contain inevitable impurities)

[0020] Clearly the size and shape of the coin blanks will depend on the size and shape of the coin being produced. Typically the coin blank will be circular and have a diameter of approximately 15-30 mm and a thickness of 1-4 mm.

[0021] The total weight of the coin blanks present is preferably 5-75 wt%, more preferably 5-50 wt% and most preferably 40-50 wt%, based on the total weight of the coin blanks and chromising compound.

[0022] The coin blanks and the chromising compound

(ferrochromium granules, energiser and optionally refractory powder) are introduced into the reactor. The furnace temperature is increased and the reactor contents are heated sufficiently to form a chromising vapour which coats the coin blanks. The temperature is preferably 800-1150°C, preferably 950-1100°C and most preferably 1000°C. The furnace preferably reaches this temperature over 10 min to 3 hours, more preferably over 1-1.5 hours. The temperature is held at this value for a sufficient time to coat substantially all of the coin blanks. For example 10 min to 12 hours, more preferably 30 min to 2 hours. After this time, when the process is being run as a batch process the furnace may be switched off and the coin blanks allowed to cool, for example to ambient temperature, for removal. It is a simple matter to separate the coated coin blanks from the chromising medium by using a suitably sized sieve.

[0023] During the chromising process the chromising compound should preferably be protected from attack by atmospheric oxygen. Protection may involve an inert atmosphere, which may be produced by ammonium salts present in the compound which decompose at elevated temperatures. Alternatively, protection may be provided by a reducing atmosphere, such as hydrogen or a hydrogen-containing gas mixture, such as a mixture hydrogen and argon having 10% hydrogen or less, preferably 5% hydrogen or less, more preferably 1-5%, e.g. Hygon (5% hydrogen in argon).

[0024] As an alternative to the batch process, the plant may be automated to allow for the continuous flow of coin blanks and chromising media through the furnace. When the process is carried out as a continuous process, the reactor is adapted to move the coin blanks from a first position where the coin blanks are charged into the reactor to a second position where the coin blanks are removed from the reactor. This may be achieved by an Archimedean screw within the reactor, or some other device for progressing the coins and powder through the hot zone. In this case, the furnace is not switched off but the coin blanks which have been coated are allowed to move into a cooler section of the reactor prior to removal. The continuous process is particularly preferably combined with inert atmosphere described hereinabove.

[0025] The present invention also includes a process for preparing coins comprising the steps of preparing coin blanks using the method described herein, finishing and polishing the coin blanks and then striking the coin blanks to provide a relief image on one or both sides of the coin. The coin blanks are finished using physical or chemical methods to remove any asperities from their surfaces, e.g. using a high-energy centrifuge containing an abrasive compound. This is followed by polishing or burnishing of the surface of the coin blanks again using physical or chemical methods, e.g. carrying out a wash and rinse in the presence of ball bearings. Striking the coin blanks to produce a relief image on one or more, normally both sides of the blanks, is achieved in the case of the latter by impacting both sides of a coin blank simultaneously

with tool steel dies which have been produced so that they will impress on the coin blank the specific design or pattern that is required. During this operation, the coin blank is held within a collar that can be used to generate the knurled edge if required.

Examples

Example 1

[0026] The following components were charged into the coating retort:

- 70 wt% low carbon ferrochromium granules having a granule size of 4-6 mm and the following composition:

65 wt% chromium
1 wt% silicon
0.05 wt% carbon
balance iron and inevitable impurities

- 15 wt% alumina
- 3 wt% ammonium chloride
- 12 wt% coin blanks of approximately 19 mm diameter and 2.3 mm thickness. The steel composition of the coin blanks was as follows:

C	0.003%
Mn	0.15%
P	0.012%
S	0.010%
Si	0.02%
N	0.005%
Al	0.05%
Ti	0.06%
Nb	0.015%
Fe	balance, with inevitable impurities

[0027] A protective atmosphere of 5% hydrogen in argon was passed into the retort at 21/min whilst the retort was rotating at 8 rpm. The furnace temperature was increased to 1000°C over 1-1.5 hours. The temperature was held at this value for 1 hour. After this time the furnace was switched off and the argon/hydrogen gas flow increased to 101/min. Once the coin blanks had achieved ambient temperature they were removed from the retort. It was a simple matter to separate them from the chromising medium by using a suitably sized sieve. The coin blanks were bright and metallic in appearance and were smooth and free of any adhering chromising media. Also, no coins were found to be sticking together. On metalurgical examination the coin blanks were found to have a chromium diffusion coating of 20-26 microns. The concentration of chromium found in the diffusion coating is shown in Fig. 2.

[0028] The metallographic section shown in Fig. 3 revealed that there was no presence of carbides within the chromised layer. The removal of the base material by etching in 20% nitric acid left the chromium diffusion coating free standing. This coating was ductile and confirmed the absence of any significant carbide. The distribution of the chromised layer around the coin blank is shown in Fig. 4. It can be seen that the layer is uniform and is uninfluenced at end or edges of the blank. This compares favourably to a coin blank which has been coated by nickel electroplating which tends to give a coating thickness of two to three times the thickness on the edges of the coin blanks compared to the centre of the faces of the coin blanks.

[0029] Coin blanks processed in the above manner may be finished to a high lustre and therefore were satisfactory for producing coinage by striking the finished blank.

Example 2

[0030] The following components were charged into the coating retort:

- 39.8 wt% low carbon ferrochromium granules having a granule size of 4-6 mm and the following composition:

65 wt% chromium
1 wt% silicon
0.05 wt% carbon
balance iron and inevitable impurities

- 8.5 wt% alumina
- 1.7 wt% ammonium chloride
- 50 wt% coin blanks having the same diameter, thickness and steel composition as in Example 1.

[0031] The procedure of Example 1 was repeated. The resultant coin blanks were bright and metallic in appearance and were smooth and free of any adhering chromising media. Also, no coins were found to be sticking together. On metallurgical examination the coin blanks were found to have a chromium diffusion coating of 20-25 microns. The concentration of chromium found in the diffusion coating was 25.4-25.7 wt%.

[0032] Coin blanks processed in the above manner may be finished to a high lustre and therefore were satisfactory for producing coinage by striking the finished blank.

Example 3

[0033] The coin blanks of the present invention may also be prepared in a continuous process. In a continuous process, the following components are charged into a

reactor via a hopper:

- 70 wt% low carbon ferrochromium granules having a granule size of 4-6 mm and the following composition:

65 wt% chromium
1 wt% silicon
0.05 wt% carbon
balance iron and inevitable impurities

- 15 wt% alumina
- 3 wt% ammonium chloride
- 12 wt% coin blanks having the same diameter, thickness and steel composition as Example 1.

[0034] A protective atmosphere of 5% hydrogen in argon is passed into the reactor at 2 l/min whilst the reactor is rotating at 2 rpm and held at a temperature of 1000°C. The coin blanks and chromising compound are introduced into one end of the reactor from a hopper. The reactor has an internal spiral fin having a 2 inch (50.8 mm) pitch and 1 inch (25.4 mm) upstand and the coin blanks are caused to move through the hot zone of the reactor by the spiral fin over a period of 30 min. It is a simple matter to separate the coin blanks from the chromising medium by using a suitably sized sieve as the coin blanks are passed out of the other end of the reactor.

[0035] Coin blanks processed in the above manner may be finished to a high lustre and therefore are satisfactory for producing coinage by striking the finished blank.

Claims

1. A process for applying a diffusion coating to coin blanks composed of steel having a carbon content of less than 0.25 wt%, comprising the steps of (i) charging a metallising reactor with a plurality of coin blanks and a chromising compound comprising ferrochromium granules, an energiser and a refractive diluent, (ii) heating the chromising compound to generate a chromising vapour for deposition on to the coin blanks, and (iii) removing the coin blanks from the reactor, wherein the reactor is rotating at a rate of 0.5-50 rpm.
2. A process as claimed in claim 1, wherein the ferrochromium granules comprise 40-80 wt% chromium, 0.05-2.5 wt% silicon and 0.025-0.25 wt% carbon, the balance being iron and inevitable impurities.
3. A process as claimed in claim 1 or 2, wherein the ferrochromium granules have a diameter of 2-8 mm.

4. A process as claimed in any preceding claim, wherein the energiser is a bromide, chloride or fluoride of sodium, potassium or ammonium.
5. A process as claimed in any preceding claim, wherein the chromising compound further comprises a refractory powder.
6. A process as claimed in claim 5, wherein the refractory powder is alumina.
7. A process as claimed in any preceding claim, wherein the coin blanks are composed of an interstitial free steel.
8. A process as claimed in any preceding claim, wherein the chromising compound comprises 15-90 wt% of ferrochromium granules and 0.1-10 wt% of an energiser, the balance being made up by the refractory powder which is present at at least 10 wt%.
9. A process as claimed in any preceding claim, wherein the total weight of the coin blanks present is 5-75 wt% based on the total weight of the coin blanks and chromising compound.
10. A process as claimed in any preceding claim, wherein the reactor is rotating a 1-10 rpm.
11. A process as claimed in any preceding claim, wherein the process is carried out as a continuous process and the reactor is adapted to move the coin blanks from a first position where the coin blanks are charged into the reactor to a second position where the coin blanks are removed from the reactor.
12. A process as claimed in any preceding claim further comprising finishing and polishing the coin blanks
13. A process for preparing coins comprising the steps of preparing coin blanks using the method of claim 12, and then striking the coin blanks to provide a relief image on one or both sides of the coin.
14. A process as claimed in claim 13, wherein the edges of the coin blanks are knurled.

Patentansprüche

1. Prozess zum Auftragen einer Diffusionsbeschichtung auf Münzrohlinge bestehend aus Stahl mit einem Kohlenstoffgehalt von unter 0,25 Gew.-%, umfassend die folgenden Schritte: (i) Beladen eines Metallisierungsreaktors mit mehreren Münzrohlingen und einer Verchromungsverbindung umfassend Ferrochromgranulat, ein Aktivierungsmittel und ein refraktives Verdünnungsmittel, (ii) Erhitzen der Ver-

chromungsverbindung, um einen Verchromungsdampf zur Abscheidung auf den Münzrohlingen zu erzeugen, und (iii) Herausnehmen der Münzrohlinge aus dem Reaktor, wobei sich der Reaktor mit einer Rate von 0,5 bis 50 min⁻¹ dreht.

2. Prozess nach Anspruch 1, wobei das Ferrochromgranulat 40-80 Gew.-% Chrom, 0,05-2,5 Gew.-% Silizium und 0,025-0,25 Gew.-% Kohlenstoff umfassen, wobei der Rest Eisen und unvermeidliche Verunreinigungen ist.
3. Prozess nach Anspruch 1 oder 2, wobei das Ferrochromgranulat einen Durchmesser von 2-8 mm aufweist.
4. Prozess nach einem vorhergehenden Anspruch, wobei das Aktivierungsmittel ein Bromid, Chlorid oder Fluorid von Natrium, Kalium oder Ammoniak ist.
5. Prozess nach einem vorhergehenden Anspruch, wobei die Verchromungsverbindung weiterhin ein feuerfestes Pulver umfasst.
6. Prozess nach Anspruch 5, wobei das feuerfeste Pulver Aluminiumoxid ist.
7. Prozess nach einem vorhergehenden Anspruch, wobei die Münzrohlinge aus einem IF-Stahl bestehen.
8. Prozess nach einem vorhergehenden Anspruch, wobei die Verchromungsverbindung 15-90 Gew.-% Ferrochromgranulat und 0,1-10 Gew.-% eines Aktivierungsmittels umfaßt, wobei der Rest aus dem feuerfesten Pulver besteht, das mit mindestens 10 Gew.-% vorliegt.
9. Prozess nach einem vorhergehenden Anspruch, wobei das Gesamtgewicht der vorliegenden Münzrohlinge 5-75 Gew.-% beträgt auf der Basis der Gesamtgewichte der Münzrohlinge und der Verchromungsverbindung.
10. Prozess nach einem vorhergehenden Anspruch, wobei sich der Reaktor mit 1 bis 10 min⁻¹ dreht.
11. Prozess nach einem vorhergehenden Anspruch, wobei der Prozess als ein kontinuierlicher Prozess durchgeführt wird und der Reaktor dafür ausgelegt ist, die Münzrohlinge von einer ersten Position, in der die Münzrohlinge in den Reaktor geladen werden, zu einer zweiten Position zu bewegen, in der die Münzrohlinge aus dem Reaktor herausgenommen werden.
12. Prozess nach einem vorhergehenden Anspruch, weiterhin umfassend die Fertigbearbeitung und das

Polieren der Münzrohlinge.

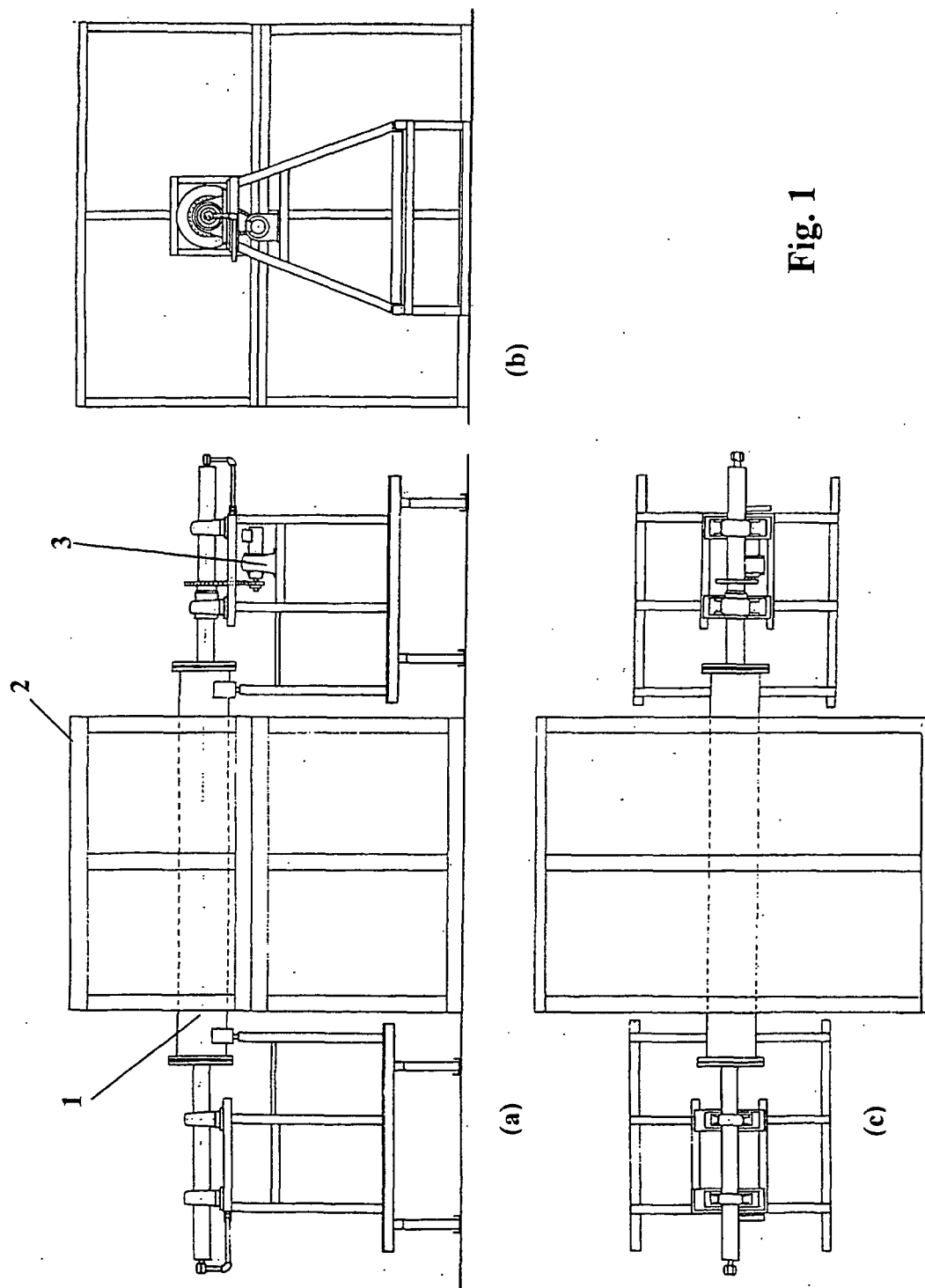
13. Prozess zum Herstellen von Münzen, umfassend die folgenden Schritte: Herstellen von Münzrohlingen unter Verwendung des Verfahrens nach Anspruch 12 und dann Prägen der Münzrohlinge, um auf einer oder beiden Seiten der Münze ein Reliefbild zu erhalten. 5
14. Prozess nach Anspruch 13, wobei die Kanten der Münzrohlinge gerändelt sind. 10

Revendications

1. Procédé d'application d'un revêtement de diffusion sur des ébauches pour pièces de monnaie composées d'acier dont la teneur en carbone est inférieure à 0,25 % en poids, comportant les phases suivantes (i) le chargement d'un réacteur de métallisation avec une pluralité d'ébauches pour pièces de monnaie et un composé de chromage contenant des granules de ferrochrome, un excitateur et un diluant de réfraction, (ii) le chauffage du composé de chromage pour générer une vapeur de chromage pour une déposition sur les ébauches pour pièces de monnaie, et (iii) l'enlèvement des ébauches pour pièces de monnaie à partir du réacteur, le réacteur tournant à une vitesse de 0,5 à 50 tr/min. 20 25 30
2. Procédé selon la revendication 1, dans lequel les granules de ferrochrome comportent 40 à 80 % en poids de ferrochrome, 0,05 à 2,5 % en poids de silicium et 0,025 à 0,25 % en poids de carbone, le reste étant du fer et des impuretés inévitables. 35
3. Procédé selon la revendication 1 ou 2, dans lequel les granules de ferrochrome ont un diamètre de 2 à 8 mm. 40
4. Procédé selon l'une quelconque des revendications précédentes, dans lequel l'excitateur est un bromure, un chlorure ou un fluorure de sodium, de potassium ou d'ammonium. 45
5. Procédé selon l'une quelconque des revendications précédentes, dans lequel le composé de chromage comporte en outre une poudre réfractaire. 50
6. Procédé selon la revendication 5, dans lequel la poudre réfractaire est de l'alumine. 55
7. Procédé selon l'une quelconque des revendications précédentes, dans lequel les ébauches pour pièces de monnaie sont composées d'acier sans interstitiels.
8. Procédé selon l'une quelconque des revendications

précédentes, dans lequel le composé de chromage comporte 15 à 90 % en poids de granules de ferrochrome et 0,1 à 10 % en poids d'un excitateur, le reste étant composé de poudre réfractaire qui est présente à un taux d'au moins 10 % en poids.

9. Procédé selon l'une quelconque des revendications précédentes, dans lequel le poids total des ébauches pour pièces de monnaie présentes est 5 à 75 % en poids basé sur le poids total des ébauches pour pièces de monnaie et du composé de chromage.
10. Procédé selon l'une quelconque des revendications précédentes, dans lequel le réacteur tourne à une vitesse de 1 à 10 tr/min. 15
11. Procédé selon l'une quelconque des revendications précédentes, dans lequel le procédé est mis en oeuvre selon un procédé continu et le réacteur est adapté pour déplacer les ébauches pour pièces de monnaie depuis une première position où les ébauches pour pièces de monnaie sont chargées dans le réacteur jusqu'à une deuxième position où les ébauches pour pièces de monnaie sont enlevées du réacteur. 20 25 30
12. Procédé selon l'une quelconque des revendications précédentes comportant le finissage et le polissage des ébauches pour pièces de monnaie, 35
13. Procédé pour préparer des ébauches comportant les phases consistant à préparer des ébauches en utilisant le procédé de la revendication 12, puis à frapper les ébauches pour fournir une image en relief sur une ou les deux faces de la pièce. 40
14. Procédé selon la revendication 13, dans lequel les bords des ébauches pour pièces de monnaie sont moletés. 45 50 55



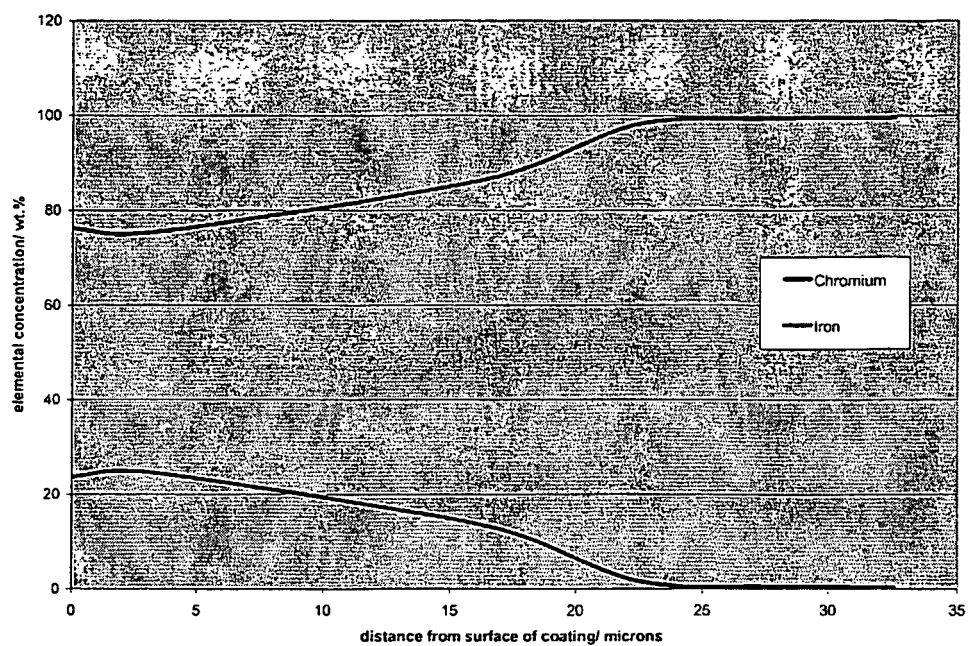


Fig. 2

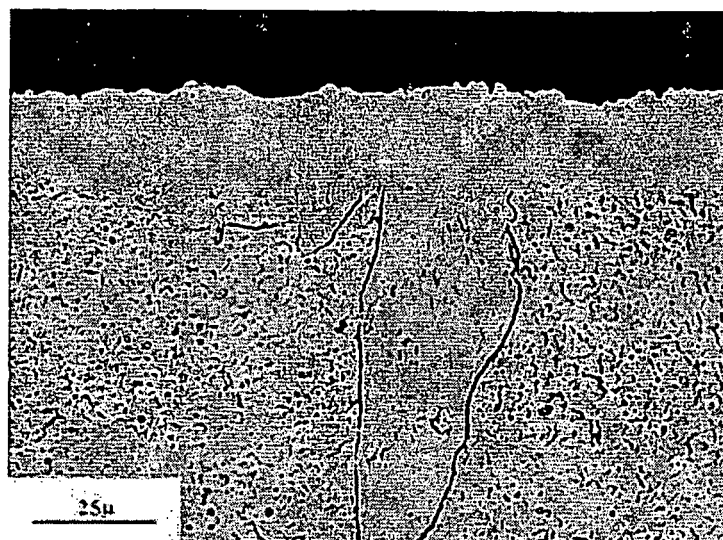


Fig. 3

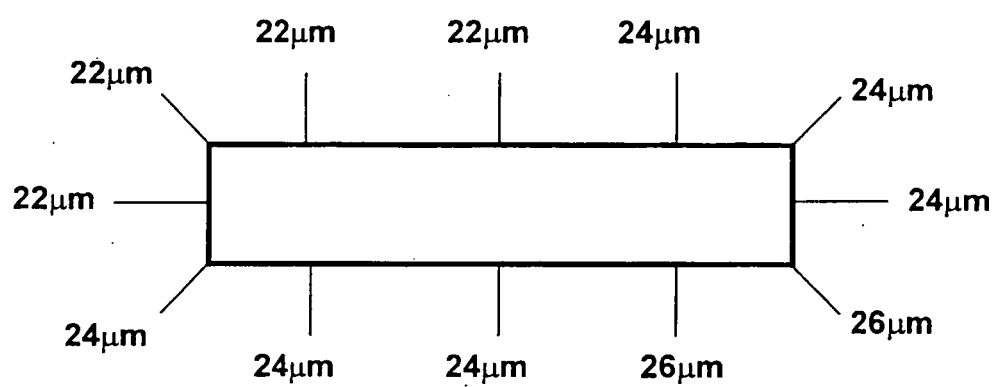


Fig. 4

REFERENCES CITED IN THE DESCRIPTION

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