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(54) **METHOD FOR THE PRODUCTION AND PICKLING OF ALUMINUM BARS**

VERFAHREN FÜR DIE HERSTELLUNG UND DAS BEIZEN VON ALUMINIUMBARREN

METHODE POUR LA FABRICATION ET LE DÉCAPAGE DES BARRES EN ALUMINIUM

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Description

[0001] The present invention relates to a method for the production of aluminium or aluminium alloy bars.

[0002] In the prior art, the production of such bars is by means of a system wherein a semi-finished product, such as a billet, is heated in a furnace and then extruded into a press to obtain the bar with a round or shaped cross-section, as needed.

[0003] The bar is then hardened, directly in a tank after the press or after transit through a solution heat treatment furnace and, after various specific processing, is sometimes aged. Lastly transit in the pickling tanks is performed to remove the surface oxides.

[0004] Usually the pickling takes place in subsequent stages: for example, a first stage of washing with soda is followed by rinsing in water, then further washing in acid and further rinsing in water.

[0005] The pickling process has numerous drawbacks. In particular, the pickling mediums (usually soda and / or potash) are dangerous to humans, harmful to health and the environment and must therefore be handled by staff using appropriate precautions and disposed of as special waste, generating significant costs.

[0006] GB 1 121 677 A describes a process for producing articles of aluminium-silicon alloys of a dark or black shade which exhibit coloured reflections, which process involves including in the alloy a quantity of one or more metals or metalloids which is or are capable of modifying the aluminium-silicon eutectic and then subjecting the article obtained from this alloy to an anodic oxidising treatment. US 3 766 763 A discloses a method the manufacture of fine wire or like products from metal rod, and particularly to a fluid cooling and lubricating system for metal rod being rolled down from a continuously cast bar. US 3 983 889 A discloses a process for cleaning the surface of strip produced on continuous casting machines in particular for strip of aluminium, zinc or their alloys, whereby the cast strips are formed between two moving endless strip molds which are spaced apart and are at least in part provided with a protective layer which is in the form of a particulate material. CN 202 398 636 U discloses a cleaning device for aluminium rods which utilizes multiple groups of cleaning units in the form of at least one spray. CN 203 754 788 U discloses a device that cleans oil on the surface of a continuously casted aluminium rod. CN 101 767 124 A discloses a material brush rod device for rotating and cleaning a bar rod by a wire brush, which can completely remove oxides on the surface of the aluminium rod. EP 2 369 020 A1 discloses a method for treating a metal element for an automobile comprising the steps of press-hardening the metal element, removing scale from the press hardened metal element in an ultrasonic liquid by an ultrasonic process and coating the metal element in a coating process with an anti-corrosion coating. JP H10 123736 A discloses a method to produce an electrophotographic photoreceptor with improved uniformity and stability of coating, elec-

trical characteristics and image characteristics. US 5 909 742 A discloses a method of cleaning metal surfaces by using a composition of citric acid, a hydroxycarboxylic acid salt, a nonionic surfactant and a coupling agent is used for cleaning metal surfaces.

[0007] The purpose of the present invention is to provide a method for the production of aluminium or aluminium alloy bars able to overcome the drawbacks referred to above.

[0008] Such purpose is achieved by a method according to the appended claims.

[0009] The characteristics and advantages of the method, according to the present invention will be evident from the description given below, by way of a non-limiting example, according to the appended drawings, wherein:

- Figure 1 is a diagram of a plant adopting a method not according to the invention;
- Figure 2 is a diagram of a plant adopting a method according to the invention;
- Figure 3 is a diagram of yet a further plant adopting a method not according to the invention;
- Figure 4 is a diagram of a further plant adopting a method not according to the invention;
- Figures 5 and 6 show photographs of a portion of bar, respectively before and after a pickling treatment according to the invention.

[0010] According to an embodiment not according to the invention (in line pickling after hardening), with reference to Figure 1, a plant 1 comprises a heating furnace 2 fed with a semi-finished starting product 4a, for example a billet, made of aluminium or aluminium alloy.

[0011] The heating furnace is suitable to heat the semi-finished product 4a up to a predefined temperature, generally comprised between 200 - 650°C; a heated billet 4b comes out of the furnace 2.

[0012] The plant 1 further comprises a press 6, downstream of the heating furnace 2, suitable to receive the heated billet 4a in input and to perform on this a plastic deformation processing, typically an extrusion, thus obtaining an extruded bar, hot enough to be able to receive the thermal hardening treatment.

[0013] The plant 1 further comprises a main tank 8, downstream of the press 6, and movement means 10, for example a conveyor belt, suitable to move the extruded bar from the press 6 inside the main tank 8.

[0014] The main tank 8 contains a solution able to perform both the hardening of the bar and the pickling (or mere cleaning) of the same, freeing it, completely or in part, of the surface oxides.

[0015] The plant comprises a closed circuit, which the main tank is part of, for the recirculation and topping up of the solution. The system comprises an open circuit, which the main tank is part of, for the drainage of the solution outside the plant, for example in a purifier.

[0016] The plant 1 further comprises further movement means 12, for example a conveyor belt, suitable to move

the hardened and pickled bar 4c outside the main tank 8, towards the processing units 14 of the plant 1 for the performance of additional processing, such as drawing and/or cutting to size.

[0017] The plant 1 further comprises an ageing furnace 16, downstream of the processing units 14 or directly downstream of the main tank 8, in which the bar undergoes an ageing process at temperature for a varying period of time. For example, said ageing process provides for a period in the furnace of the bar at 120° C for 24 hours or at 170° for 12 hours.

[0018] When the ageing is completed, the bars 4d are generally transferred to a warehouse for storage.

[0019] According to the invention (in line pickling after solution heat treatment), with reference to Figure 2, a plant 100 comprises a heating furnace 102 supplied with the semi-finished starting product 4a; the heating furnace 102 is suitable to heat the semi-finished product 4a up to a predefined temperature, generally comprised between 200-650°C; a heated billet 4b comes out of the furnace 102.

[0020] The plant 100 further comprises a press 106, downstream of the heating furnace 102, suitable to receive in input the heated billet 4b and to obtain the extruded bar 4e.

[0021] The plant 100 further comprises a solution heat treatment furnace 105, downstream of the press 106, suitable to heat the extruded bar 4e to a predetermined temperature between 350° - 600° C on the surface of the bar 4e.

[0022] Moreover, the plant 100 comprises a main tank 108, downstream of the press 106 and the solution heat treatment furnace 105, and movement means 110, for example a conveyor belt, suitable to move the annealed bar 4f from the solution heat treatment furnace 105 inside the main tank 108.

[0023] The main tank 108 contains the solution able to perform both the hardening of the bar and the pickling of the same, freeing it, completely or in part, of the surface oxides.

[0024] According to one embodiment, the plant comprises a closed circuit, which the main tank is part of, for the recirculation and topping up of the solution. According to a further embodiment, the system comprises an open circuit, which the main tank is part of, for the drainage of the solution outside the plant, for example in a purifier.

[0025] According to a further embodiment, the plant 100 further comprises processing units 114 for the performance of additional processing, such as drawing and/or cutting to size, and/or an ageing furnace 116, downstream of the processing units 114 or directly downstream of the main tank 108, in which the bar undergoes an ageing process at temperature for a varying period of time. For example, said ageing process provides for a period in the furnace of the bar at 120° C for 24 hours or at 170° for 12 hours.

[0026] According to the invention, in the main tank 108 both the hardening and the pickling (or simple cleaning)

of the bar takes place simultaneously, through the use of a suitable solution.

[0027] According to a further embodiment not according to the invention (off line pickling), according to figure 3, a plant 200 comprises a heating furnace 202 supplied with the semi-finished starting product 4a, which the heated billet 4b comes out of, a press 206, downstream of the heating furnace 202, suitable to receive in input the heated billet 4b and to obtain the extruded bar 4e and a hardening tank 209, downstream of the press 206.

[0028] The hardening tank 209 contains hardening solution able to carry out the hardening of the extruded bar, obtaining a hardened bar 4g.

[0029] Off-line, for example after the performance of any additional processing, and a storage period of the hardened bar 4g, said hardened 4g bar is subjected to a pickling treatment in a main tank 208 containing the solution able to perform the pickling, freeing the bar, completely or in part, of the surface oxides. Said pickling treatment is performed after heating the bar and / or heating the solution, so as to activate the chemical pickling process.

[0030] According to a further embodiment not according to the invention, the hardening process or hardening and pickling process take place by striking the bar with a jet of a solution.

[0031] For example, according to Figure 4, a plant 300 is provided with jet means 308, for example, structurally integrated with the press 6, together with the forming die of the bar.

[0032] The jet means 308 are suitable to strike the formed bar in the press with a jet of a suitable solution to achieve the hardening and the simultaneous pickling and / or full or partial cleaning of the surface oxides from the bar.

[0033] The appropriate solution for performing the simultaneous hardening and pickling or pickling only comprises water and a predefined amount of an organic acid. The organic acid is selected from the group comprising citric acid and tartaric acid or combinations thereof.

[0034] Solutions containing 1 - 100% of organic acid have proved suitable. Preferably, solutions are used containing from 1% to 50% of organic acid, more preferably from 10% to 30% of organic acid, even more preferably from 5% to 10% of organic acid.

[0035] By way of example, Figure 5 is a photograph showing a cross-section of bar at 550°C before hardening and simultaneous pickling, while Figure 6 is a photograph which shows the same portion of bar as Figure 5, after hardening and contemporary pickling in a solution of water and citric acid, at a concentration of between 10% and 30%.

[0036] The bar before hardening and simultaneous pickling and the relative solution contained in the main tank 8, 108 (Figures 1 and 2) or sprayed by the jet means 308 (Figure 4), constitute a plant, the thermodynamic state of which allows activation of the pickling, since it has the energy needed to activate the chemical process.

[0037] For example, immediately before the hardening and pickling treatment, the solution is "cold", i.e. kept at ambient temperature, while the bar is "hot", i.e. is at a sufficiently high temperature so that when immersed in the solution it activates the pickling action of the latter.

[0038] Similarly, the bar before pickling alone and the relative solution contained in the main tank 208 (Figure 3) constitute a plant, the thermodynamic state of which allows activation of the pickling, since it has the energy needed to activate the chemical process.

[0039] For example, immediately before the pickling treatment, the solution is "cold", i.e. kept at ambient temperature, while the bar is "hot", i.e. is brought to a sufficiently high temperature so that when immersed in the solution it activates the pickling action of the latter; or the solution is "hot", i.e. kept at a predefined temperature higher the ambient temperature, and the bar is "cold."

[0040] In further embodiments, both the bar and the solution are sufficiently "hot".

[0041] Innovatively, the method according to the present invention make it possible to overcome the drawbacks of the prior art.

[0042] In particular, advantageously, the solution containing the organic acid does not have an environmental impact such as to be treated as special waste and disposed of accordingly and, at least within certain limits, is not particularly dangerous to man.

[0043] For example, in the case of a solution of water and citric acid or tartaric acid, this is practically harmless both for humans and for the environment (for example, the citric acid is contained in lemon juice, while the non-toxicity of tartaric acid is mentioned in some texts such as "Food Additive Toxicology" by Joseph A. Maga, Anthony T. Tu ISBN 0-8247-9245-9).

[0044] According to a further advantageous aspect, the present invention permits a considerable energy saving, adequately exploiting the thermal energy possessed by the bar before hardening. In fact, before hardening, the bar is at a sufficiently high temperature to be effectively hardened; at the same time, this thermal energy is used to activate the pickling action of the solution when the bar is immersed in it, or struck by it.

[0045] According to yet a further advantageous aspect, the invention makes it possible to considerably reduce production times.

[0046] Moreover, advantageously, the invention makes it possible to lengthen the life of the plant, as it has no components in contact with highly corrosive agents such as soda and / or potash.

[0047] It is clear that a person skilled in the art may make modifications to the method in accordance to the appended claims.

Claims

1. Method for the production of a bar of aluminium or aluminium alloy, wherein an extruded bar (4e) un-

dergoes a solution heat treatment in a solution heat treatment furnace (105), this treatment heats the bar to a temperature between 350 - 600°C;

wherein a pickling and/or cleaning treatment of the bar, after solution heat treatment (4f), is then carried out using a solution of water and citric acid or water and tartaric acid or combinations thereof, having reached a state of activation of the pickling process;

wherein both the pickling treatment and a hardening treatment of the bar, after solution heat treatment (4f), are carried out simultaneously.

2. Method according to claim 1, wherein the bar is hardened directly after machining by a press (6).

3. Method according to any of the claims from 1 to 2, comprising an ageing treatment performed on the hardened and pickled bar.

4. Method according to any one of the previous claims, wherein the pickling treatment is carried out by immersion in a main tank (8,108,208) containing the solution.

5. Method according to any of the claims from 1 to 3, wherein the pickling treatment takes place using jet means (308) which strike the bar with the solution.

6. Method according to any of the previous claims, wherein the pickling treatment takes place in a closed circuit for the recirculation of the solution.

7. Method according to any of the claims from 1 to 5, wherein the pickling treatment takes place in an open circuit for the discharge of the solution.

Patentansprüche

1. Verfahren zur Herstellung einer Stange aus Aluminium oder einer Aluminiumlegierung, wobei eine extrudierte Stange (4e) in einem Lösungswärmebehandlungsofen (105) einer Lösungswärmebehandlung unterzogen wird, diese Behandlung die Stange auf eine Temperatur zwischen 350 und 600 °C erhitzt;

wobei eine Beiz- und/oder Reinigungsbehandlung der Stange, nach der Lösungswärmebehandlung (4f), unter Verwendung einer Lösung aus Wasser und Zitronensäure oder Wasser und Weinsäure oder Kombinationen davon durchgeführt wird, nachdem ein Aktivierungszustand des Beizprozesses erreicht wurde;

wobei sowohl die Beizbehandlung als auch eine Härtungsbehandlung der Stange nach der Lö-

- sungswärmebehandlung (4f) gleichzeitig durchgeführt wird.
2. Verfahren nach Anspruch 1, wobei die Stange unmittelbar nach Bearbeitung durch eine Presse (6) gehärtet wird. 5
 3. Verfahren nach einem der Ansprüche 1 bis 2, umfassend eine Alterungsbehandlung, die an der gehärteten und gebeizten Stange durchgeführt wird. 10
 4. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Beizverfahren durch Eintauchen in einen Haupttank (8, 108, 208) durchgeführt wird, der die Lösung enthält. 15
 5. Verfahren nach einem der Ansprüche 1 bis 3, wobei die Beizbehandlung unter Verwendung von Strahlmitteln (308) erfolgt, welche die Stange mit der Lösung beaufschlagen. 20
 6. Verfahren nach einem der vorhergehenden Ansprüche, wobei das Beizverfahren in einem geschlossenen Kreis für die Rückführung der Lösung erfolgt. 25
 7. Verfahren nach einem der Ansprüche 1 bis 5, wobei das Beizverfahren in einem offenen Kreis für die Entladung der Lösung erfolgt. 30

Revendications

1. Méthode pour la production d'une barre en aluminium ou en alliage d'aluminium, dans laquelle une barre extrudée (4e) subit un traitement thermique de mise en solution dans un four de traitement thermique de mise en solution (105), ce traitement chauffe la barre jusqu'à une température entre 350 et 600 °C ; 35
 dans laquelle un traitement de décapage et/ou de nettoyage de la barre, après un traitement thermique de mise en solution (4f), est alors réalisé en utilisant une solution d'eau et d'acide citrique ou d'eau et d'acide tartrique ou des combinaisons de ceux-ci, ayant atteint un état d'activation du procédé de décapage ; 40
 dans laquelle à la fois le traitement de décapage et un traitement de durcissement de la barre, après un traitement thermique de mise en solution (4f), sont réalisés simultanément. 45
 50
2. Méthode selon la revendication 1, dans laquelle la barre est durcie directement après un usinage par une presse (6). 55
3. Méthode selon l'une quelconque des revendications 1 à 2, comprenant un traitement de vieillissement

effectué sur la barre durcie et décapée.

4. Méthode selon l'une quelconque des revendications précédentes, dans laquelle le traitement de décapage est réalisé par immersion dans une cuve principale (8, 108, 208) contenant la solution.
5. Méthode selon l'une quelconque des revendications 1 à 3, dans laquelle le traitement de décapage a lieu en utilisant des moyens gicleurs (308) qui frappent la barre avec la solution.
6. Méthode selon l'une quelconque des revendications précédentes, dans laquelle le traitement de décapage a lieu dans un circuit fermé pour la recirculation de la solution.
7. Méthode selon l'une quelconque des revendications 1 à 5, dans laquelle le traitement de décapage a lieu dans un circuit ouvert pour le déversement de la solution.

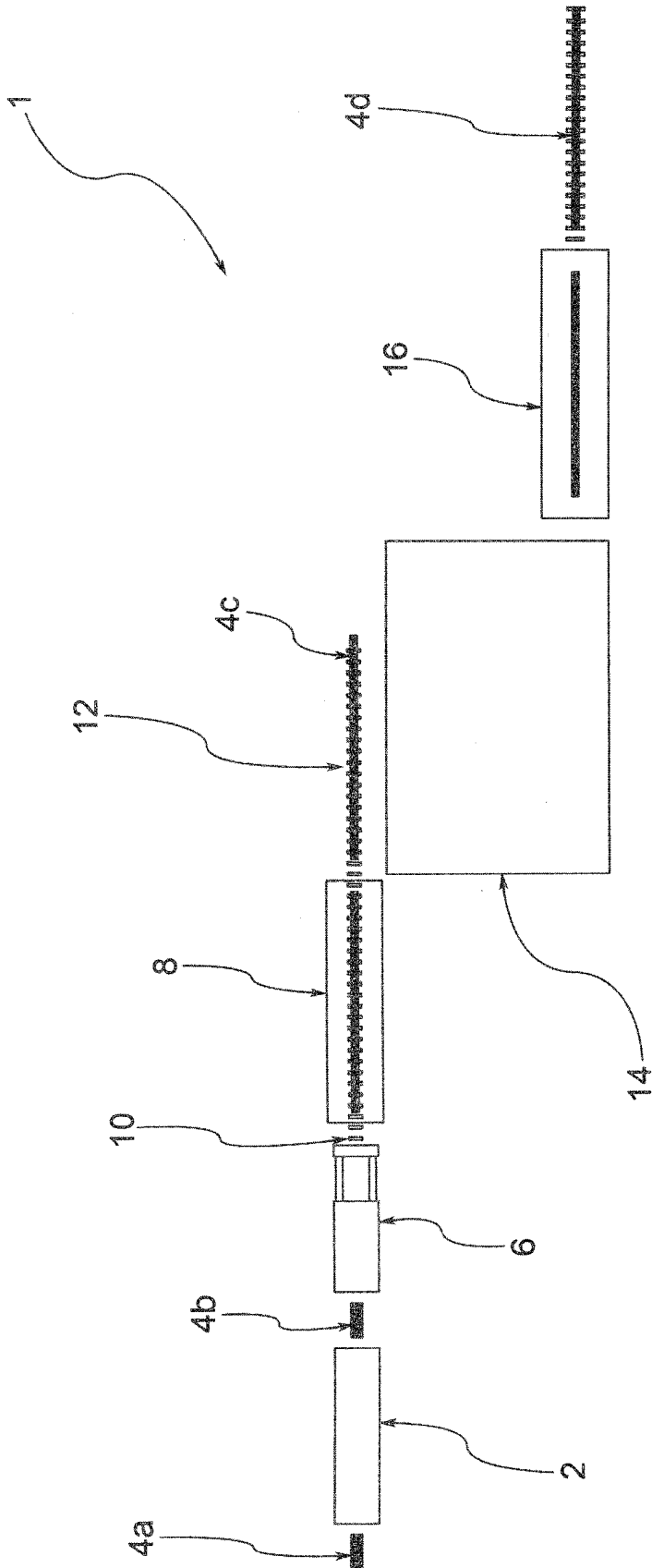


FIG.1

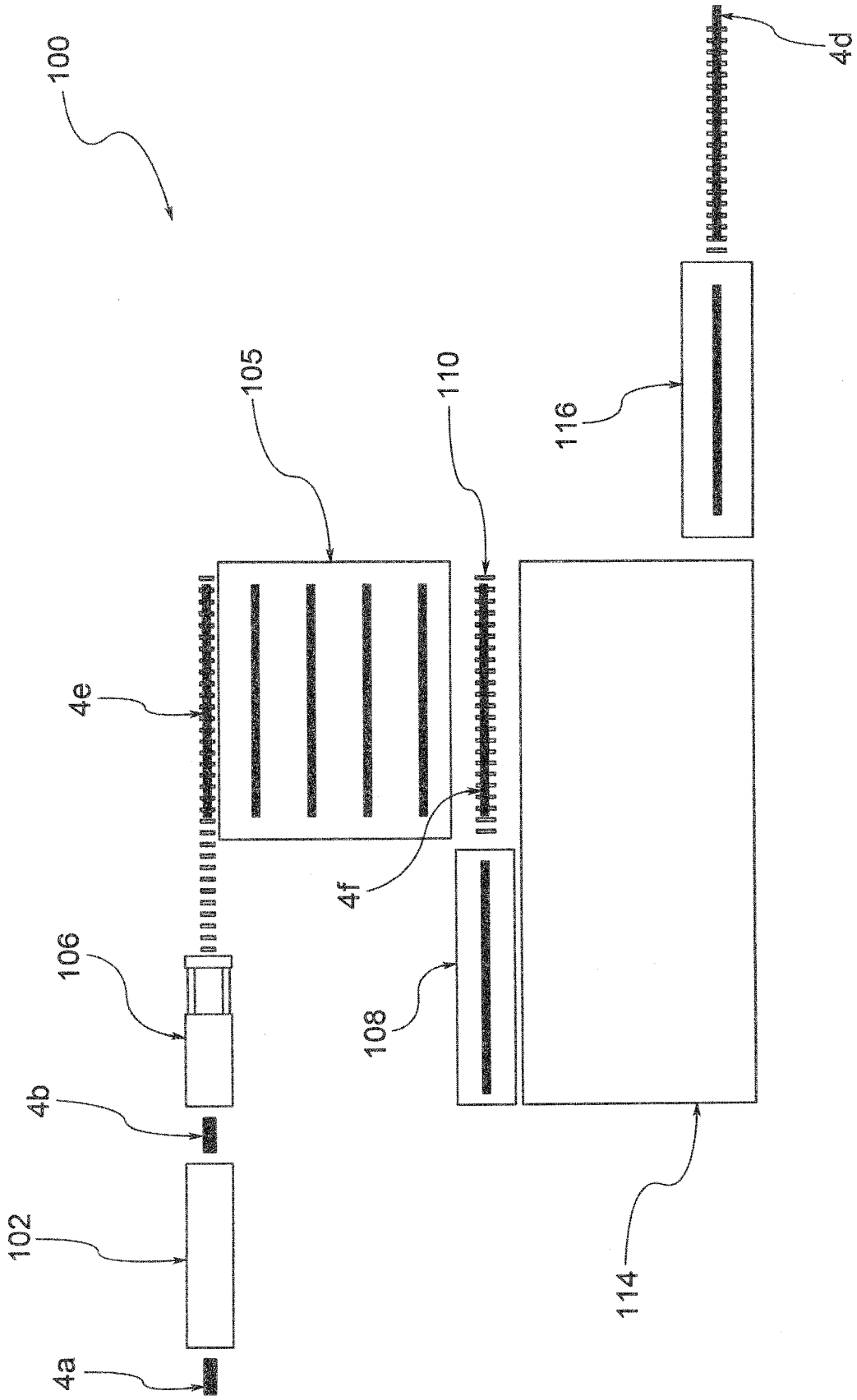


FIG.2

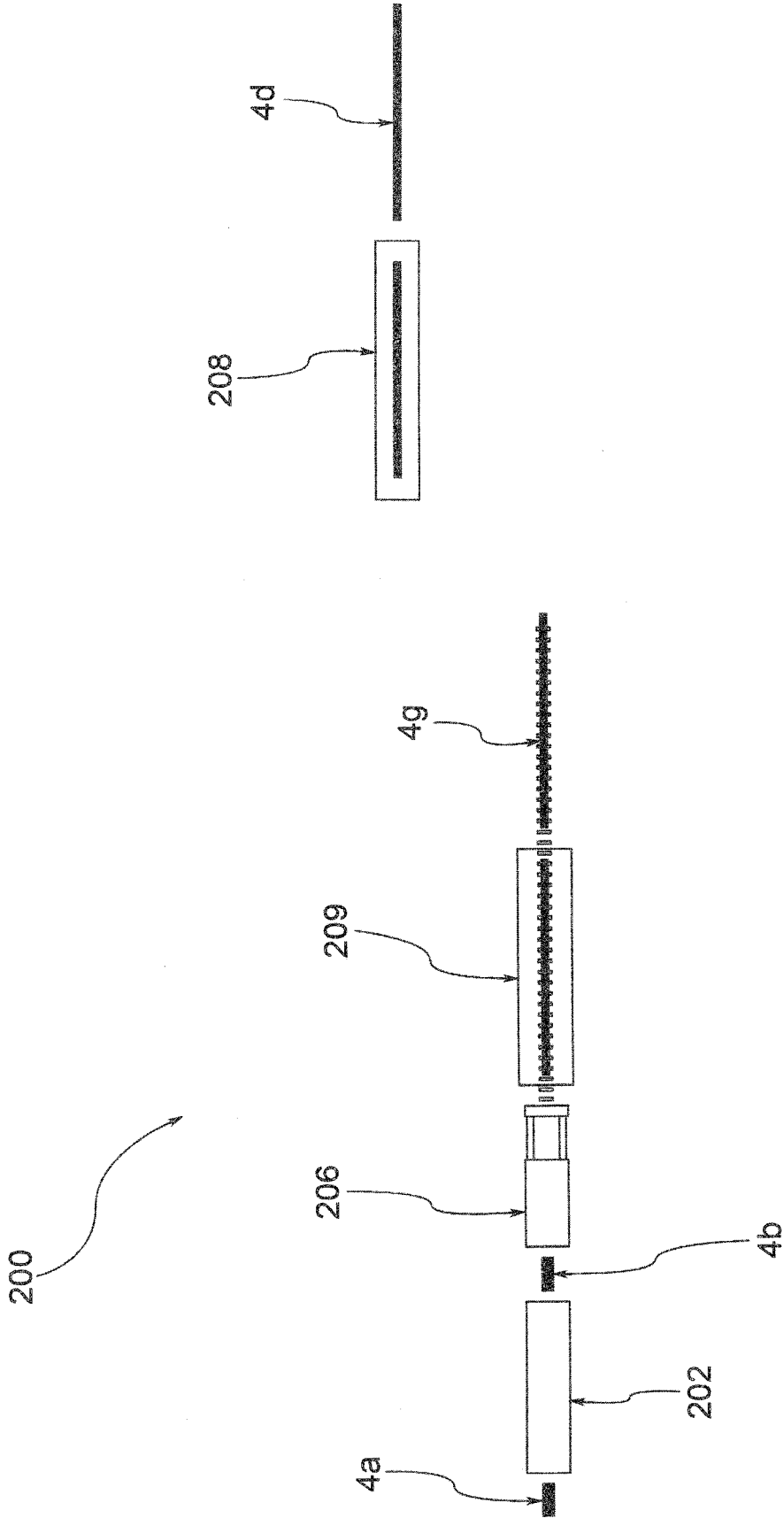


FIG.3

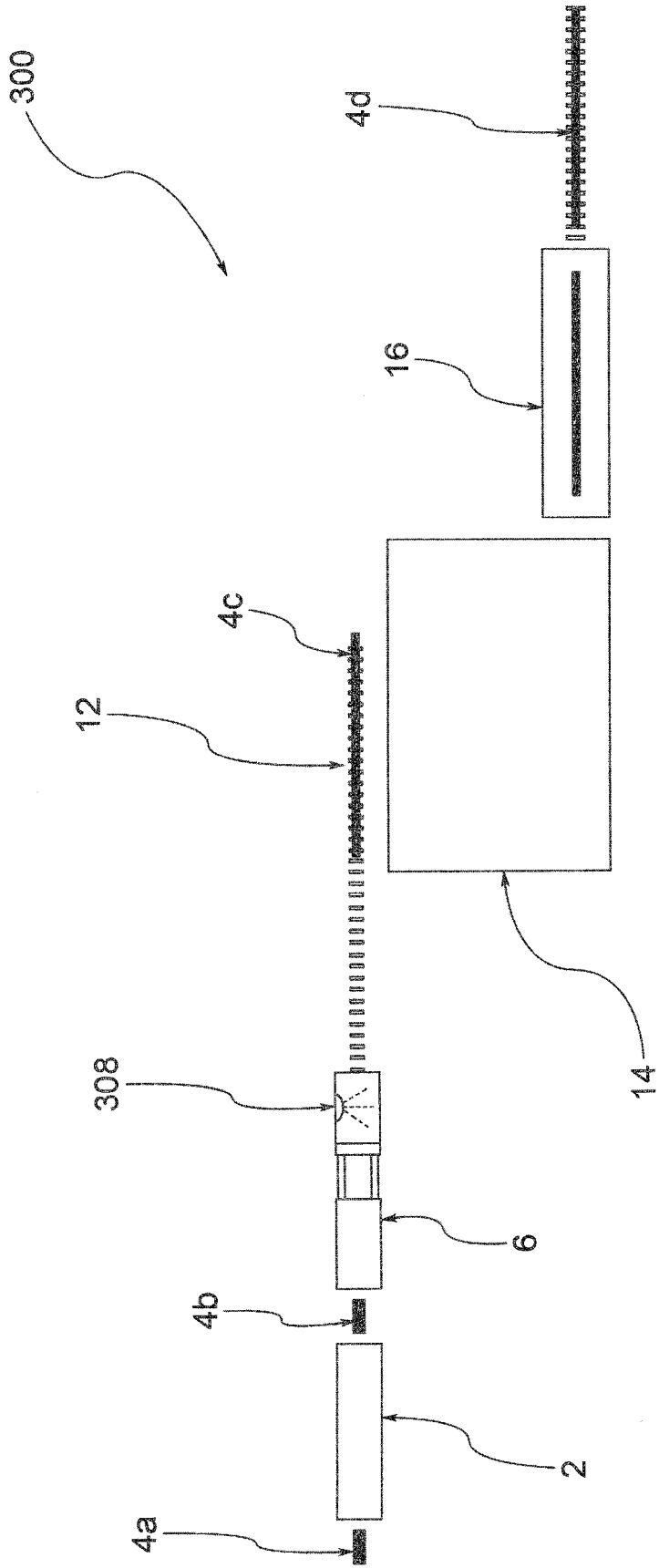


FIG.4

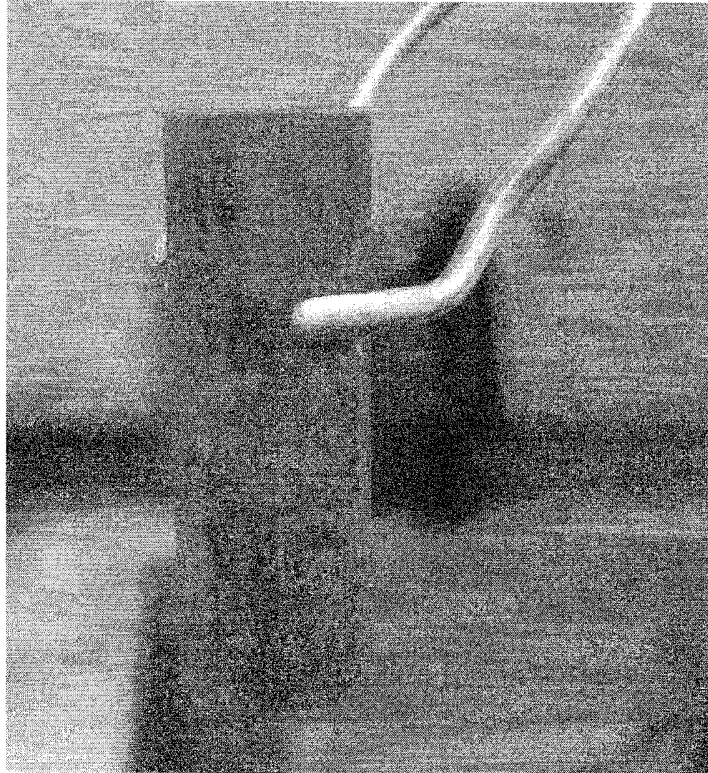


FIG. 5



FIG. 6

REFERENCES CITED IN THE DESCRIPTION

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