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

(57) A plant and a method for producing aluminium bars provides for the use of a solution of water and an organic acid to perform the pickling treatment, possibly together with a hardening treatment.

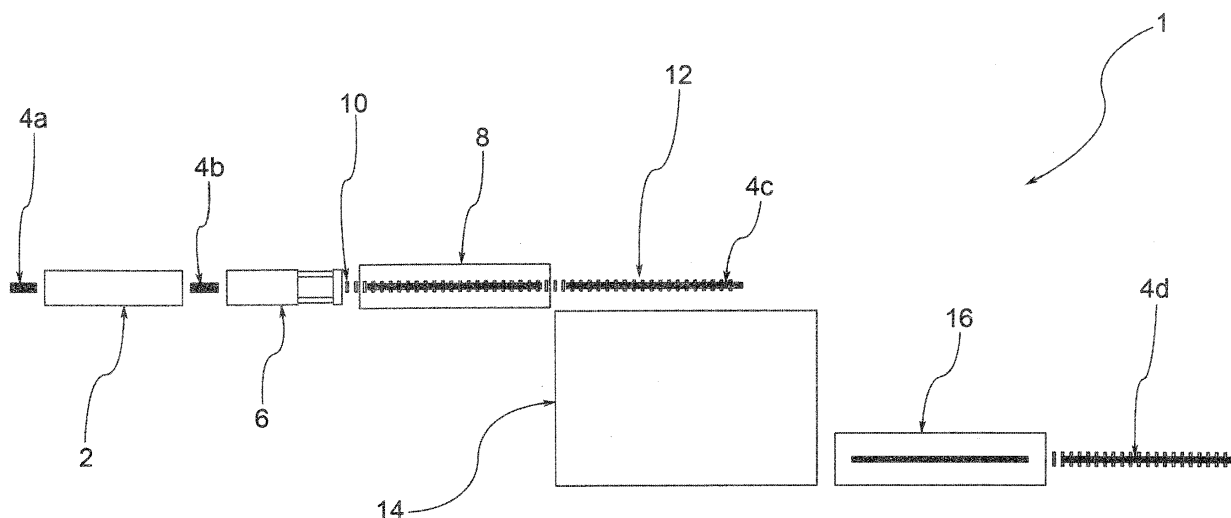


FIG.1

Description

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

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

[0007] Such purpose is achieved by a method, a plant and the use thereof according to the appended claims.

[0008] The characteristics and advantages of the method, plant and use thereof 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:

[0009] - Figure 1 is a diagram of a plant adopting a method according to the present invention, according to a first embodiment of the invention;

[0010] - Figure 2 is a diagram of a further plant adopting a method according to a further embodiment of the invention;

[0011] - Figure 3 is a diagram of yet a further plant adopting a method according to yet a further embodiment of the invention;

[0012] - Figure 4 is a diagram of a further plant adopting a method according to a further embodiment of the invention;

[0013] - Figures 5 and 6 show photographs of a portion of bar, respectively before and after a pickling treatment according to the invention.

[0014] According to an embodiment of the present 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.

[0015] The heating furnace is suitable to heat the semi-finished product 4a up to a predefined temperature, gen-

erally comprised between 200 - 650°C; a heated billet 4b comes out of the furnace 2.

[0016] 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 a extruded bar, hot enough to be able to receive the thermal hardening treatment.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] According to a further embodiment, 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.

[0022] When the ageing is completed, the bars 4d are generally transferred to a warehouse for storage.

[0023] According to a further embodiment of the invention (in line pickling after solubilisation), 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.

[0024] 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.

[0025] The plant 100 further comprises a solubilisation furnace 105, downstream of the press 106, suitable to heat the extruded bar 4e to a predetermined temperature, for example between 350 ° - 600 ° C on the surface of the bar 4e.

[0026] Moreover, the plant 100 comprises a main tank 108, downstream of the press 106 and the solubilisation furnace 105, and movement means 110, for example a

conveyor belt, suitable to move the solubilised bar 4f from the solubilisation furnace 105 inside the main tank 108.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] According to an aspect of the invention, in the main tank 8, 108 both the hardening and the pickling (or simple cleaning) of the bar takes place, preferably simultaneously, through the use of a suitable solution.

[0031] According to a further embodiment of 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.

[0032] The hardening tank 209 contains hardening solution able to carry out the hardening of the extruded bar, obtaining a hardened bar 4g.

[0033] 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.

[0034] According to a further embodiment of the invention, the hardening process or hardening and pickling process take place by striking the bar with a jet of a solution.

[0035] 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.

[0036] 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.

[0037] The appropriate solution for performing the simultaneous hardening and pickling or pickling only comprises water and a predefined amount of an organic acid. Preferably, the organic acid is selected from the group comprising citric acid, tartaric acid, acetic acid, formic acid, oxalic acid and combinations thereof.

[0038] 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.

[0039] 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%.

[0040] 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.

[0041] 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.

[0042] 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.

[0043] 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."

[0044] In further embodiments, both the bar and the solution are sufficiently "hot".

[0045] Innovatively, the method, the plant and use thereof according to the present invention make it possible to overcome the drawbacks of the prior art.

[0046] 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.

[0047] 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, An-

thony T. Tu ISBN 0-8247-9245-9).

[0048] 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.

[0049] According to yet a further advantageous aspect, the invention makes it possible to considerably reduce production times.

[0050] 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.

[0051] It is clear that a person skilled in the art may make modifications to the method and plant described above so as to satisfy contingent requirements.

[0052] For example, the treatment of pickling only off-line according to further embodiments of the invention, is performed after a possible solubilisation treatment and / or between any additional processing.

[0053] According to further examples, the treatment of pickling only off-line, according to further embodiments of the invention, is performed after a treatment of hardening only and / or between any additional processing.

[0054] According to yet further examples, the jet means are used for hardening only and/or pickling only by means of the appropriate solution.

[0055] Such examples are also contained within the scope of protection defined by the following claims.

Claims

1. Method for the production of a bar of aluminium or aluminium alloy, wherein a pickling and/or cleaning treatment of a bar (4c) is carried out using a solution of water and organic acid, having reached a state of activation of the pickling process.
2. Method according to claim 1, wherein the organic acid is selected from the group containing citric acid, tartaric acid, acetic acid, formic acid, oxalic acid and combinations thereof.
3. Method according to claim 1 or 2, wherein the pickling treatment is carried out during a hardening treatment of the bar.
4. Method according to claim 3, wherein the bar, before the immersion in a hardening medium, undergoes a solubilisation treatment in a solubilisation furnace (105).
5. Method according to claim 3, wherein the bar is hardened directly after machining by a press (6).
6. Method according to any of the claims from 3 to 5, comprising an ageing treatment performed on the hardened and pickled bar.
7. 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 of water and organic acid.
8. Method according to any of the claims from 1 to 6, wherein the pickling treatment takes place using jet means (308) which strike the bar with the solution of water and organic acid.
9. Method according to any of the previous claims, wherein the pickling treatment takes place in a closed circuit for the recirculation of the solution.
10. Method according to any of the claims from 1 to 8, wherein the pickling treatment takes place in an open circuit for the discharge of the solution.
11. Plant (1,100,200) for the production of bars of aluminium or aluminium alloy, comprising a main tank (8,108,208) containing a solution of water and organic acid to perform a pickling and / or cleaning treatment of surface oxides of a bar.
12. Plant according to claim 11, wherein the main tank (8,108,208) is part of a closed circuit for the recirculation of the solution.
13. Plant according to claim 11, wherein the main tank (8,108,208) is part of an open circuit for the discharge of the solution.
14. Plant for the production of bars of aluminium or aluminium alloy, comprising jet means (308) operating with a solution of water and organic acid suitable to strike a bar with said solution and perform a pickling and/or cleaning treatment of surface oxides of said bar.
15. Plant according to claim 14, wherein said jet means (308) are integrated with a press (6) for the formation of the bar.
16. Method for the production of a bar of aluminium or aluminium alloy, wherein a pickling and/or cleaning treatment of the surface oxides of a bar (4c) is carried out during a hardening treatment of said bar (4c), by immersion in a predefined solution and having reached a state of activation of the hardening and pickling process.
17. Plant (1,100) for the production of bars of aluminium or aluminium alloy, comprising a main tank (8,108) containing a solution suitable to perform a hardening

and pickling and/or cleaning treatment of the surface oxides of a bar.

18. Plant (300) for the production of bars of aluminium or aluminium alloy, comprising jet means (308) operating with a solution of water and organic acid suitable to strike a bar with said solution and perform a hardening and pickling and/or cleaning treatment of the surface oxides of said bar. 5
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19. In a plant for the production of bars of aluminium or aluminium alloy, use of a solution comprising water and an organic acid for the performance of a pickling and/or cleaning treatment of the surface oxides of the bar. 15
20. In a plant for the production of bars of aluminium or aluminium alloy, use of a solution comprising water and an organic acid for the performance of a hardening and simultaneous pickling and/or cleaning treatment of the surface oxides of the bar. 20

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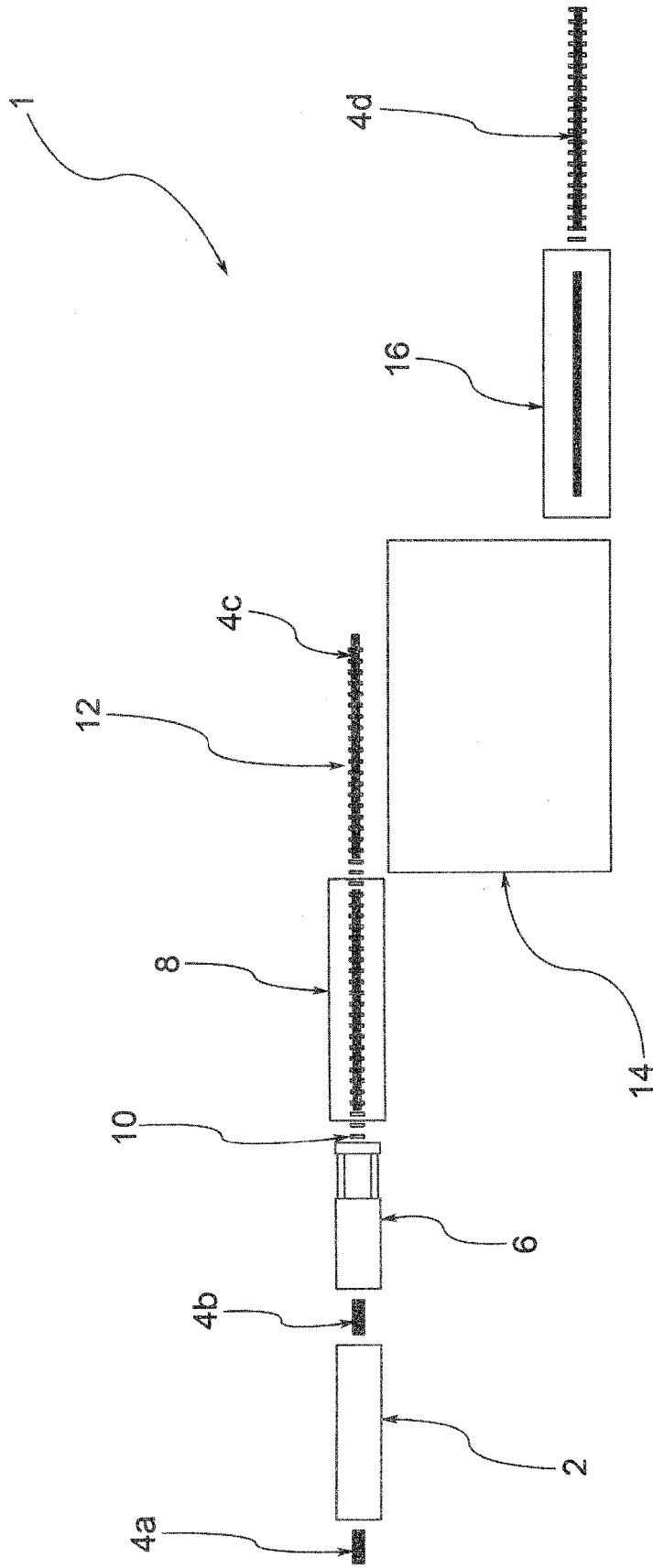
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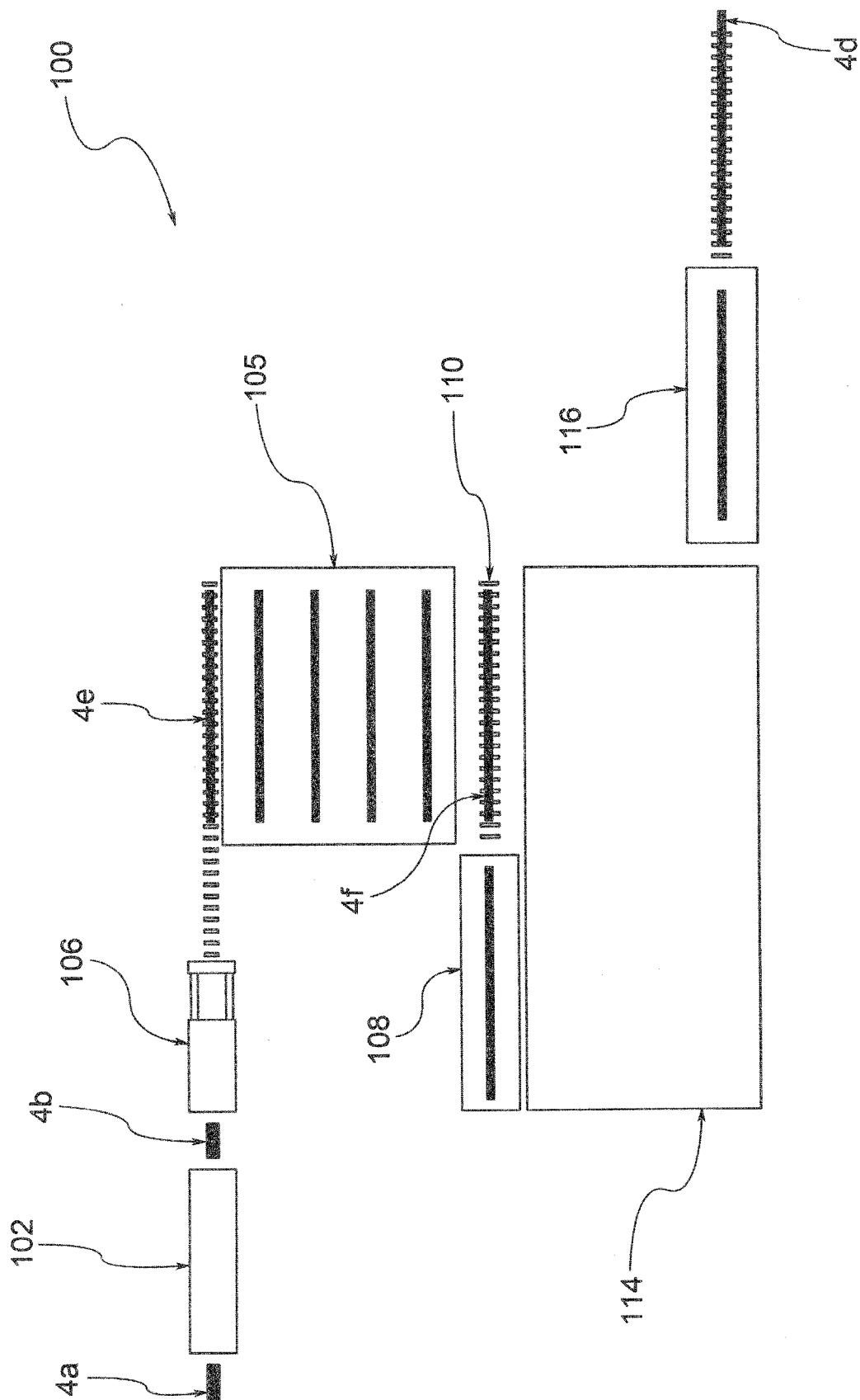


FIG.2

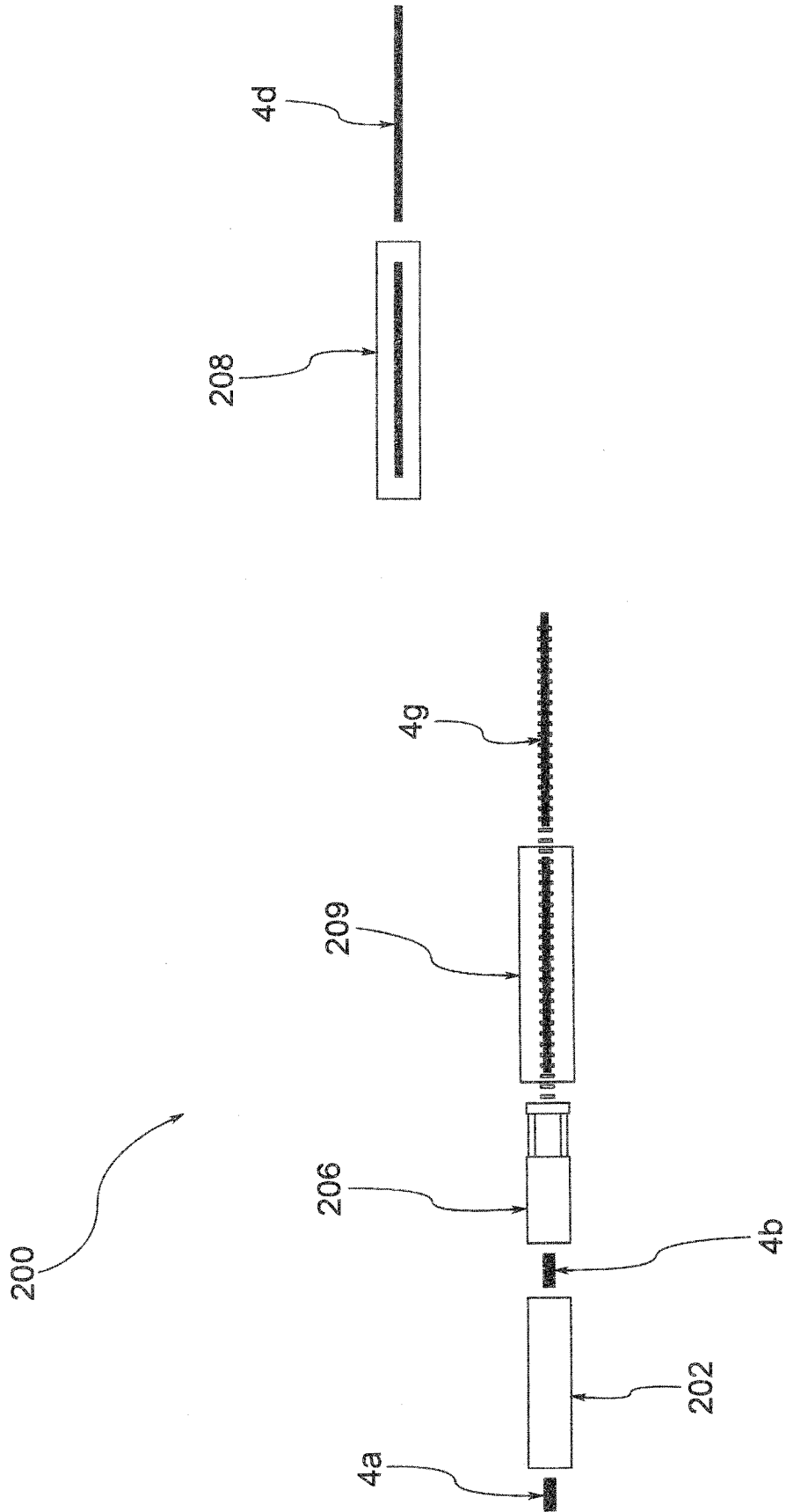


FIG.3

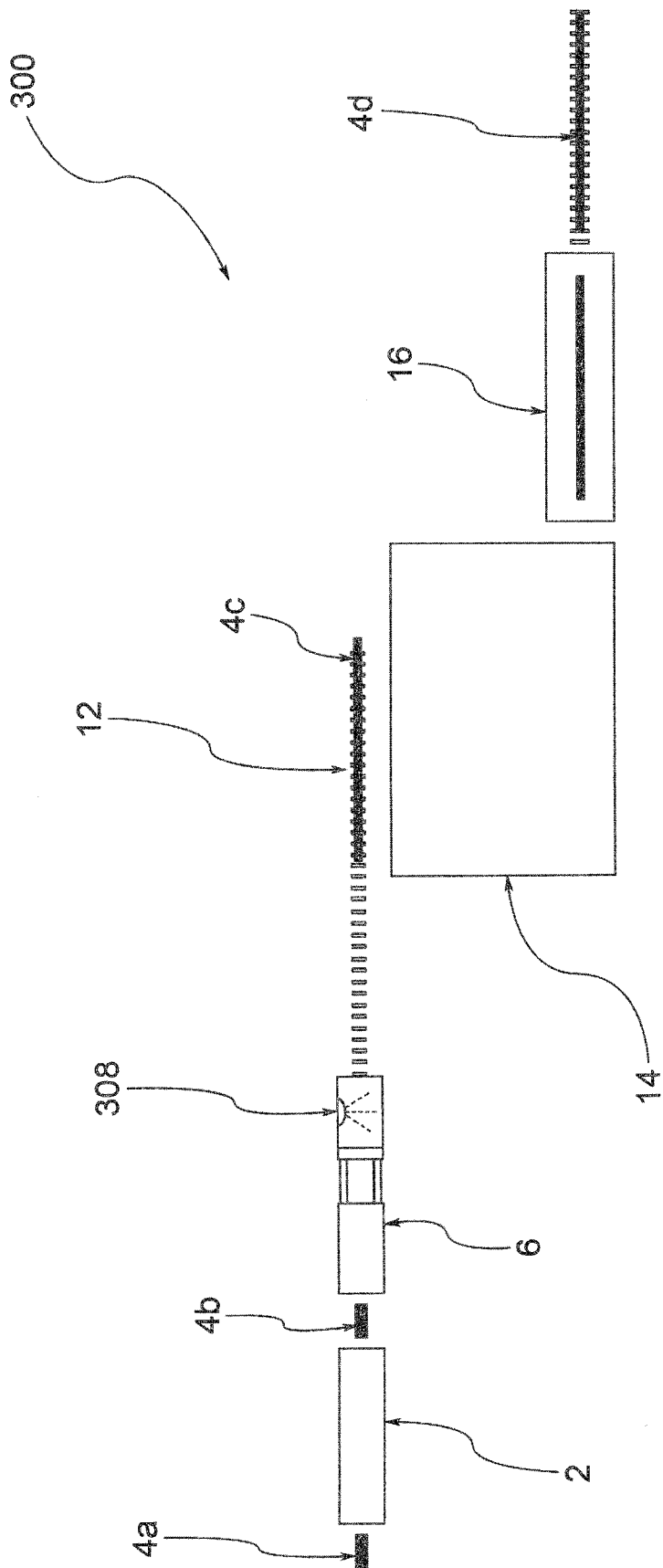


FIG.4

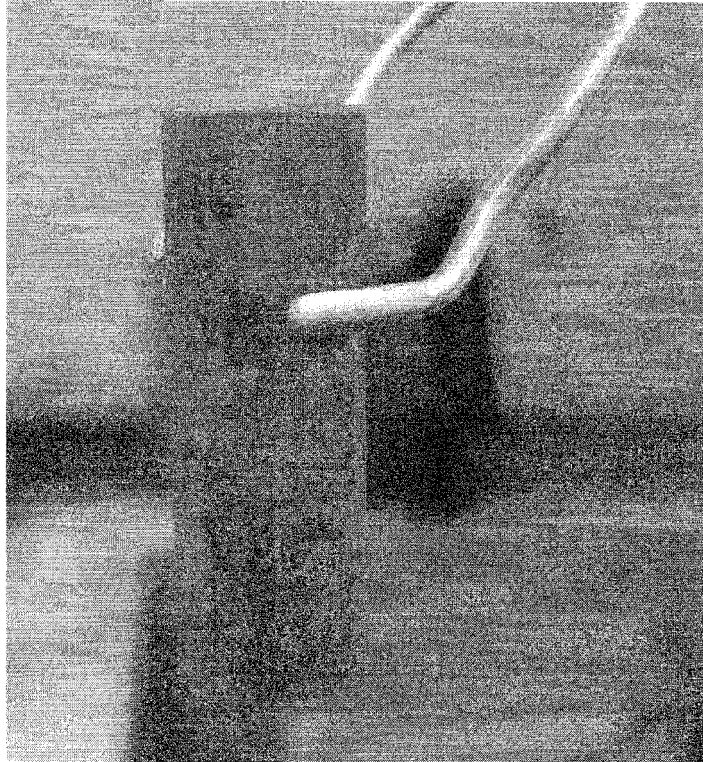


FIG. 5



FIG. 6



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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 3 537 895 A (LESLIE E. LANCY, ELLWOOD CITY, PA, LANCY LABORATORIES INC) 3 November 1970 (1970-11-03)	1-3,7, 11,16, 17,19,20	INV. C23G1/12 C22C21/00
Y	* column 1, lines 36-48 * * column 2, lines 17-21 * * column 3, line 70 - column 4, line 68 * * column 5, line 36 - column 6, line 23 * * column 8, line 64 - column 9, line 38 * * column 9, lines 52-70 *	10,13, 14,18	C23G3/02 B21C43/00 B21C33/00 B21B45/02 B21B3/00
X	GB 1 394 694 A (MONTEDISON SPA) 21 May 1975 (1975-05-21)	1,7,11, 19	
Y	* page 2, lines 12-26, 73-105, 114-127 * * page 3, line 57 - page 4, line 69 * * example 4 * * example 3 *	10,13, 14,18	
X	GB 1 121 677 A (PECHINEY PROD CHIMIQUES SA) 31 July 1968 (1968-07-31)	16	
Y	* page 1, line 40 - page 2, line 31 * * examples I-III *	1,4,5	TECHNICAL FIELDS SEARCHED (IPC)
X	US 3 766 763 A (COFER D ET AL) 23 October 1973 (1973-10-23)	14,18	C23G C22C B21C B21B
Y	* the whole document *	1,5,6,8, 10,15	
X	US 3 983 889 A (THYM GUNTER ET AL) 5 October 1976 (1976-10-05)	14,18	
Y	* the whole document *	1,5,8,10	
X	CN 202 398 636 U (TIANJIN JINHE BIMETAL WIRE CO LTD) 29 August 2012 (2012-08-29)	14,18	
Y	* abstract; figure 1 *	1,8,9,12	
----- -/--			
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 May 2016	Examiner Handrea-Haller, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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 Application Number
 EP 16 15 1146

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	CN 203 754 788 U (CHINA HUNAN CHUANGYUAN ALUMINIUM INDUSTRY CO LTD) 6 August 2014 (2014-08-06)	11,17	
Y	* abstract; figure 1 *	1,9,10,12,13	
X	----- CN 101 767 124 A (TAISHAN KAM KIU ALUMINUM EXTRU) 7 July 2010 (2010-07-07)	14,18	
Y	* abstract; figures 1, 1a, 2a, 2b, 3a, 3b, 4a, 4b, 5, 6, 7 *	1,5,6,8,10,13,15	
Y	----- CN 201 419 234 Y (GUORONG JIA) 10 March 2010 (2010-03-10)	1,4,5	
	* abstract; figures 1-4 *		
			TECHNICAL FIELDS SEARCHED (IPC)
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 31 May 2016	Examiner Handrea-Haller, M
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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ON EUROPEAN PATENT APPLICATION NO.**

EP 16 15 1146

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The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

31-05-2016

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3537895 A	03-11-1970	NL 6605461 A US 3537895 A	28-10-1966 03-11-1970
GB 1394694 A	21-05-1975	DE 2252712 A1 GB 1394694 A	10-05-1973 21-05-1975
GB 1121677 A	31-07-1968	BE 673051 A CH 448669 A FR 1427043 A GB 1121677 A NL 6515542 A	31-05-1966 15-12-1967 04-02-1966 31-07-1968 03-06-1966
US 3766763 A	23-10-1973	AT 327138 B AU 466886 B2 AU 501299 B2 AU 4778072 A AU 8503375 A BE 790448 A1 DE 2252722 A1 FR 2213110 A1 GB 1412423 A GB 1412424 A GB 1412425 A NL 7214384 A US 3766763 A US 3881336 A US 3881337 A	12-01-1976 13-11-1975 14-06-1979 26-04-1974 27-11-1975 15-02-1973 02-05-1974 02-08-1974 05-11-1975 05-11-1975 05-11-1975 26-04-1974 23-10-1973 06-05-1975 06-05-1975
US 3983889 A	05-10-1976	BE 829246 A1 CA 1068066 A CH 569533 A5 DE 2521770 A1 FR 2271884 A1 GB 1506462 A IT 1038081 B JP S50159423 A NL 7505901 A NO 751723 A SE 7505607 A US 3983889 A	15-09-1975 18-12-1979 28-11-1975 04-12-1975 19-12-1975 05-04-1978 20-11-1979 24-12-1975 24-11-1975 21-11-1975 21-11-1975 05-10-1976
CN 202398636 U	29-08-2012	NONE	
CN 203754788 U	06-08-2014	NONE	
CN 101767124 A	07-07-2010	NONE	

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 16 15 1146

5

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31-05-2016

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
CN 201419234	Y	10-03-2010	NONE

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45

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