

(12) PATENT
(19) AUSTRALIAN PATENT OFFICE

(11) Application No. AU 199743827 B2
(10) Patent No. 721431

(54) Title
Solderless brazing of aluminium

(51)⁷ International Patent Classification(s)
B23K 035/363

(21) Application No: **199743827**

(22) Application Date: **1997.09.06**

(87) WIPO No: **WO98/10887**

(30) Priority Data

(31) Number	(32) Date	(33) Country
19636897	1996.09.11	DE

(43) Publication Date : **1998.04.02**

(43) Publication Journal Date : **1998.05.28**

(44) Accepted Journal Date : **2000.07.06**

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(56) Related Art
US 4906307
DE 19519515
JP 61-206593



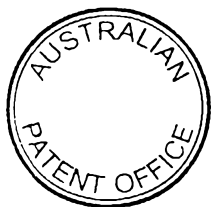
(51) Internationale Patentklassifikation ⁶ : B23K 35/363 // 103/10	A1	(11) Internationale Veröffentlichungsnummer: WO 98/10887 (43) Internationales Veröffentlichungsdatum: 19. März 1998 (19.03.98)
(21) Internationales Aktenzeichen: PCT/EP97/04851 (22) Internationales Anmeldedatum: 6. September 1997 (06.09.97) (30) Prioritätsdaten: 196 36 897.9 11. September 1996 (11.09.96) DE (71) Anmelder (für alle Bestimmungsstaaten ausser US): SOLVAY FLUOR UND DERIVATE GMBH [DE/DE]; Hans-Böckler-Allee 20, D-30173 Hannover (DE). (72) Erfinder; und (75) Erfinder/Anmelder (nur für US): BORN, Thomas [DE/DE]; Über der Kirche 1, D-31188 Holle (DE). BELT, Heinz-Joachim [DE/DE]; Haferkamp 19, D-30938 Burgwedel (DE). (74) Anwalt: LAUER, Dieter; Solvay Pharmaceuticals GmbH, Hans-Böckler-Allee 20, D-30173 Hannover (DE).		(81) Bestimmungsstaaten: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DK, EE, ES, FI, GB, GE, HU, IL, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, TJ, TM, TR, TT, UA, UG, US, UZ, VN, ARIPO Patent (GH, KE, LS, MW, SD, SZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches Patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI Patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG). Veröffentlicht <i>Mit internationalem Recherchenbericht.</i> <i>Vor Ablauf der für Änderungen der Ansprüche zugelassenen Frist. Veröffentlichung wird wiederholt falls Änderungen eintreffen.</i>
(54) Title: SOLDERLESS BRAZING OF ALUMINIUM (54) Bezeichnung: LOTFREIES ALUMINIUMLÖTEN (57) Abstract Disclosed is a method for the brazing of aluminium wherein the addition of solder is no longer necessary. To this effect a flux is used containing 6-50 wt % potassium fluorosilicate and 50-94 wt % potassium fluoroaluminate. The flux can, for example, be applied in the form of an aqueous suspension. (57) Zusammenfassung Offenbart wird ein Verfahren zum Aluminiumlöten, bei welchem der Zusatz eines Lotes nicht mehr notwendig ist. Man verwendet zu diesem Zweck ein Flußmittel, welches 6 bis 50 Gew.-% Kaliumfluorsilikat und 50 bis 94 Gew.-% Kaliumfluoraluminat enthält. Das Flußmittel kann beispielsweise in Form einer wäßrigen Aufschlämmung eingesetzt werden.		

Solderless brazing of aluminium

The invention relates to a method for solderless brazing of aluminium and a flux suitable for this purpose.

In soldering, metallic materials are joined with the aid of a molten solder. Fluxes are used in soldering to ensure a clean surface and hence secure joining of the materials. Fluxes which achieve this object very well with respect to brazing of aluminium have already been developed. Fluxes on the basis of potassium fluoroaluminates have proved particularly well suited. The preparation of potassium fluoroaluminates and their use as fluxes is described, for example, in US Patents 3,951,328; 4,428,920; 4,579,605; 5,318,764; in German Offenlegungsschrift DE 195 19 515 A1; German Patent Application ... (195 20 812) and German Patent Application ... (195 37 216). US Patent 4,906,307 discloses fluxes for brazing aluminium-based alloys, the flux containing 70 to 90% by weight K_2SiF_6 and 30 to 10% by weight AlF_3 . This flux may if desired be used with further additions such as lithium fluoride or sodium fluoride. A dispersing agent may also be used.

The aluminium brazing methods known from the prior art are always performed such that a solder metal also has to be applied to the metal components to be joined in addition to the flux. According to the teaching of US Patents 5,100,048 and 5,190,596, this may also be accomplished such that a metal such as silicon, copper or germanium is admixed to the flux. According to other methods, it is possible to proceed by using aluminium components which are plated with the solder metal. The disadvantage of the known methods is that they always comprise an operating step which provides



for the application or mixing in of the solder metal or other metals such as silicon, copper or germanium. It is an object of the present invention to provide a method for brazing of aluminium which permits brazing without a solder metal being required. This object is achieved by the method according to the invention and a flux and a flux preparation for application in the method according to the invention.

The method according to the invention for brazing of aluminium using a flux containing potassium fluoroaluminate provides for carrying it out without the addition of a solder and for a flux to be used which contains or consists of 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate. If it contains less than 6% by weight of the fluorosilicate, the quality of the brazed join deteriorates. Preferably the flux contains 7 to 30% by weight K_2SiF_6 . The flux then contains the potassium fluoroaluminate in a quantity of 93 to 70% by weight. In particular, the content is 7 to less than 30% by weight K_2SiF_6 and 93 to more than 70% by weight potassium fluoroaluminate. The term "potassium fluoroaluminate" comprises the known complex aluminium fluorides of potassium which are composed of potassium, aluminium, fluorine and optionally water. Preferred fluxes in the spirit of the invention contain $KAlF_4$, K_2AlF_5 and/or $K_2AlF_5 \cdot H_2O$ as potassium fluoroaluminate. K_3AlF_6 is not contained, or is contained only in small amounts, for example up to 5% by weight, in the flux. In this case, the pentafluoroaluminate may also be present in the form of irreversibly dehydrated product, the preparation of which by heating the hydrated material to temperatures above about $260^\circ C$ is described in German Offenlegungsschrift DE 195 19 515 A1.

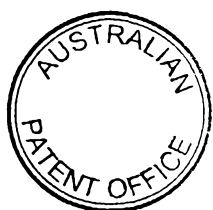


The flux may be used as such, optionally with the joint use of conventional auxiliaries. For example, a binder which brings about the adhesion of the flux to the surface of the aluminium components which are to be joined may be provided as auxiliary.

Expediently, the flux is used in the form of a flux preparation which contains the flux as a slurry or paste in water, an organic liquid or a mixture of water and organic liquid. Expediently, the substances usually used as organic solvents, such as alcohols, in particular methanol, ethanol, propanol or isopropanol, are used as "organic liquid". For preparation of the composition, K_2SiF_6 and potassium fluoroaluminate may be mixed individually or as a mixture with the liquid phase.

The content of water or of the organic liquid is adjusted such that the desired consistency is achieved in terms of the slurry or the paste. The slurry or paste advantageously contains 3 to 70% by weight of the flux, and the remainder to make up to 100% by weight is water or the organic liquid, any impurities and any further auxiliaries such as dispersing agents.

The method according to the invention can be used for components made of aluminium or aluminium alloys. However, the magnesium content in alloys should be less than 0.5% by weight. The brazing can be performed in conventional manner, for example in a furnace or by means of burners. The suitable brazing temperature may optionally be determined by small-scale tests. Optimally, aluminium can be brazed in a temperature range from 580°C to 605°C.



The coating of the components to be brazed can be effected in conventional manner, for example by dipping, spraying, sprinkling, printing or coating.

5 The method according to the invention is generally suitable for the brazed joining of components made of aluminium or aluminium alloy without the addition of solder. In particular, it is suitable for brazing radiators and heat exchangers, for example for the automobile industry, and in the electronics industry
10 for brazing conductors of all types and sizes. For example, it is also possible to braze thin foils.

A further subject of the invention is a solderless flux. It is distinguished in that it contains 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium
15 fluoroaluminate, or consists of these two substances. Preferred quantities of these two substances and potassium fluoroaluminates which are preferably to be used are described further above. If desired, conventional auxiliaries such as binders may be jointly
20 contained in the flux. The solderless flux according to the invention may also be present in the form of a kit, with the substances being separate from one another and being intended for joint use in the method according to the invention.

25 A further subject of the invention is a solderless flux preparation. It comprises a content, effective for solderless brazing of aluminium, of a flux which contains 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate, and also additional
30 conventional auxiliaries, in particular water and/or organic liquids. A preferred solderless flux preparation comprises 3 to 70% by weight of the flux and also water and/or organic liquids as remainder to make up to 100% by weight and also optionally further



conventional auxiliaries such as binders or dispersing agents.

5 The use of K_2SiF_6 and potassium fluoroaluminate for the preparation of a flux or a flux preparation which is suitable for solderless brazing of aluminium or aluminium alloys is novel and is likewise a subject of the invention.

10 The invention permits the brazing of aluminium without separate addition of a solder or a metal. This facilitates the technical application and in addition reduces the costs of the brazing process.

The following examples are intended to explain the invention further, without restricting its scope.

15 Example 1: Preparation of a flux according to the invention

2.5 g K_2SiF_6 and 10 [g] Nocelok®, a potassium fluoroaluminate on the basis of $KAlF_4$ and K_2AlF_5 , manufactured by Solvay Fluor und Derivate GmbH, were mixed together in finely divided form.

20 Example 2: Preparation of a flux slurry according to the invention

a) 5 g water were mixed with 2.5 g K_2SiF_6 and 10 g Nocelok®, forming an aqueous slurry with approximately 43% by weight solids content.

25 b) 5 g water were mixed with 12.5 g of the flux obtained according to Example 1, forming an aqueous slurry having approximately 43% by weight solids content.



Example 3: Use of a slurry containing K_2SiF_6 and Nocolok® in brazing

General: Angled pieces of dimensions 40 x 5 x 05 [sic] mm of aluminium alloy AA3003 were brazed to aluminium plates of dimensions 25 x 25 x 0.3 mm of the same material. The components were dipped into the flux-containing slurry and then heated with a propane-gas burner.

The slurry was prepared by mixing the given quantities of water, K_2SiF_6 and Nocolok®.

Example	Quantity of H_2O [g]	Quantity of K_2SiF_6 [g]	Quantity of Nocolok® [g]	Result
3.1	5	2.5	10	brazed
3.2	12	3.0	18	brazed
3.3	180	7.0	31	brazed
3.4	180	8.0	31	brazed
3.5	180	9.0	31	brazed
3.6	180	10	31	brazed
3.7	180	12	31	brazed

Example 4: Brazing in a brazing furnace

This was performed analogously to Example 3.5, but the components were introduced into a brazing furnace heated to approximately 600°C. The pieces were removed from the furnace in brazed state.

The terms "comprise", "comprises", "comprised" and "comprising" when used in this specification are taken to specify the presence of stated features, integers, steps or components but does not preclude the presence or addition of one or more other features, integers, steps, components or groups thereof.



Claims

1. A method for the brazing of aluminium using a flux containing potassium fluoroaluminate, characterised in that it is carried out without the addition of a solder and a flux is used which contains 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate.
2. A method according to Claim 1, characterised in that $KAlF_4$, K_2AlF_5 and/or $K_2AlF_5 \cdot H_2O$ is used as potassium fluoroaluminate.
3. A method according to Claim 1, characterised in that the flux contains K_2SiF_6 in a quantity of 7 to 30% by weight.
4. A method according to Claim 1, characterised in that a flux preparation is used which contains the flux in the form of a slurry or paste in water, an organic liquid or a mixture of water and an organic liquid.
5. A method according to Claim 1, characterised in that the brazing of aluminium is performed at a temperature of 580°C to 605°C.
6. A solderless flux having a content of 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate, optionally in the form of a kit, which contains the individual substances existing separately from one another for joint use.
7. A solderless flux preparation, comprising a content, effective for solderless brazing of aluminium, of a flux which contains 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate, and also



additional conventional auxiliaries.

8. A solderless flux preparation of claim 7 wherein the conventional auxiliaries are water and/or organic liquids.

9. The use of K_2SiF_6 and/or potassium fluoroaluminate for the preparation of a flux which contains 6 to 50% by weight K_2SiF_6 and 50 to 94% by weight potassium fluoroaluminate, or for the preparation of a flux preparation which contains an effective quantity of the flux, usable for the solderless brazing of aluminium.

DATED this 6th day of April, 2000

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