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(58) Field of search
C7A

(54) **Aluminum alloy pigment**

(57) An aluminum alloy suitable for use as a pigment for a paint for protecting a steel surface from rust and/or heat, contains (i) more than 25 to 50% by weight of zinc, (ii) from 10 to 25 % by weight of silicon, (iii) optionally, from 0.01 to 0.2% by weight of indium and/or 0.01 to 2.0% by weight of tin, with (iv) the balance being aluminum and impurities. A process for the preparation of the pigment and a paint comprising the pigment and a binder are also claimed.

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SPECIFICATION

Aluminum alloy pigment

- 5 This invention relates to an aluminum alloy pigment having the excellent anti-corrosive and heat-resisting properties. 5
- In a case of newly building large-sized ships, bridges, tanks and the like with a reduced term of work and a labor saving, a block system is adopted. In accordance with the block system, steel plates are subjected to a shot blasting to remove mill scales, rusts and the like followed by coating with a shop primer. Then the steel
- 10 plates are built up into blocks via heat treatment steps such as gascutting, fusing, welding and tempering and the thus-built blocks are subjected to a block coating. 10
- The shop primer is used to prevent the steel plates from rusting till the block coating and so is requested to have an excellent anti-corrosive property. And, the shop primer is also requested to have an excellent heat-resisting property since the films coated with the shop primer are subjected to the heat treatment. At
- 15 present, among the commercially available shop primer, for example a wash primer, a zinc-rich primer, a non-zinc primer and the like, the zinc-rich primer which is a paint incorporating a large amount of an inorganic zinc powder as a pigment in a binder such as alkali silicate, alkyl silicate and so on is preferably employed. 15
- The zinc-rich primer shows the excellent anti-corrosive property because zinc has a sacrificial anodic effect toward iron enough to prevent the steel plate from rusting. Such as excellent anti-corrosive property, however, cannot be maintained when the steel plates coated with the zinc-rich primer is heated at high
- 20 temperature even if as the binder alkyl silicate or alkali silicate which are heat resistant are used. Because, zinc is easily volatilized as a hume during the heat treatment due to its low melting point and as a result the sacrificial anodic effect toward iron cannot be expected since zinc has been already disappeared from the
- 25 film. In addition, the zinc hume produced is troublesome since it is poisonous so as to handle with a specific attention. Further, in the zinc-rich primer there is the other problem that the film coated therewith tends to easily crack or peel when the film is suddenly heated at high temperature. As mentioned above, the zinc-rich primer is unsatisfactory with respect to the heat-resisting property. 25
- It has been known that an aluminum - zinc alloy wherein aluminum having the excellent heat-resisting property is contained to improve the heat-resisting property of the zinc-rich primer is used as the pigment. In
- 30 order to further improve the heat-resisting property, the addition of a minor amount of the other alloying ingredient such as indium has also been proposed. But, these alloys cannot be satisfied with both the anti-corrosive and heat-resisting properties since the heat-resisting property is more improved and the anti-corrosive property is contrarily impaired accompanying the increase of the aluminum content. 30
- 35 Therefore, the pigments satisfied with both the anti-corrosive and heat-resisting properties are not found until now. 35
- The present invention provides an aluminum alloy containing
- (i) more than 25 to 50% by weight of zinc,
- (ii) from 10 to 25% by weight of silicon,
- 40 (iii) optionally from 0.01 to 0.2% by weight of indium and/or from 0.01 to 2.0% by weight of tin, and 40
- (iv) the balance being aluminum and impurities.
- Generally, up to 2% by weight of impurities such as iron, magnesium, manganese, tin and/or copper may be present.
- The invention further provides a pigment composition comprising an aluminium alloy according to the
- 45 invention. It is thus possible to provide a pigment the anti-corrosive property of which can be maintained after heating at high temperature. Hereinafter aluminum alloy pigment of this invention is referred to as "the present pigment". 45
- As mentioned above, zinc has a sacrificial anodic effect toward iron and gives the excellent anti-corrosive property to the present pigment. The zinc content in the present pigment is more than 25% by weight to 50%
- 50 by weight. When the zinc content is 25% by weight or less, it is impossible to obtain pigment having an excellent anti-corrosive property. On the other hand, when the zinc content is more than 50% by weight, it is also impossible to obtain pigment having an excellent heat-resisting property. The zinc content is preferably 30 to 40% by weight. 50
- Silicon contributes towards the improvement of the anti-corrosive property of the pigment, although it is
- 55 theoretically impossible for silicon to have a sacrificial anodic effect toward iron. The improvement of the anti-corrosive property by the addition of silicon is probably due to that silicon extracts the sacrificial anodic effect of aluminum toward iron. Aluminum can be theoretically expected to have the sacrificial anodic effect toward iron enough to prevent the steel plate from rusting, but actually such an effect is entirely unfound because aluminum has the tendency to quickly form on its new surface the coating in the passive state which
- 60 is not electrically conductive. While, silicon is supposed to act to prevent the forming of the passivated coatings and/or to form the coatings with high conductivity, thereby the sacrificial anodic effect of aluminum toward iron being combined with that of zinc so as to improve the anti-corrosive property of the pigment while maintaining the heat-resisting property of aluminum. The silicon content in the present pigment is 10 to 25 % by weight. When the silicon content is less than 10 % by weight, it is impossible to give the
- 65 improvement of the anti-corrosive property to the pigment. On the other hand, when the silicon content is 65

more than 25 % by weight the anti-corrosive property is rather lowered since the electrode potential of the alloy approaches to that of iron with the increase of the added amount of silicon which is noble with respect to the electrode potential as compared with iron. The silicon content is preferably 12 to 20% by weight.

The thus-formulated aluminum - zinc - silicon alloy pigment can maintain its excellent anti-corrosive property when heated at high temperature, for example at about 700°C.

To further improve the heat-resisting property of the pigment, the present pigment may contain a minor amount of indium and/or tin as the fourth alloying ingredient. The pigment wherein 0.01 to 0.2 % by weight of indium and/or 0.01 to 2.0 % by weight of tin is added to the above-mentioned aluminum - zinc - silicon alloy has the excellent anti-corrosive property when heated at the temperature more than about 700°C, for example at about 800°C.

The improvement of the heat-resisting property by the addition of indium and/or tin is probably due to that the coatings are formed on the surface of the alloy particles to prevent the oxidation of the alloy or the volatilization of zinc since the boiling points of these metal are high although the melting points thereof are very low. The indium content in the present pigment is 0.01 to 0.2 % by weight. When the indium content is out of the above-mentioned range, it is insufficient to give the improvement of the heat-resisting property to the pigment. The indium content is preferably 0.02 to 0.10 % by weight. The tin content in the present pigment is 0.01 to 2.0 % by weight. When the tin content is less than 0.01 % by weight, it is not sufficient to give the heat-resisting property to the pigment. On the other hand, when the tin content is more than 2.0 % by weight, the anti-corrosive property of the pigment is contrarily lowered. The tin content is preferably 0.02 to 1.0 % by weight.

As mentioned above, the present pigment is satisfied with both the anti-corrosive and heat-resisting properties. And, the present pigment provides the film which is very difficultly peeled when suddenly heated at high temperature owing to the addition of silicon in the pigment. In this case, silicon is supposed to act to improve the adhesion of the pigment with the binder so as to obtain the film firmly bound with the binder. Further, as the present pigment has the specific gravity rather smaller than the prior zinc pigment, it is difficultly sedimented in the paint and the handling thereof is easier although the prior zinc pigment is readily and easily sedimented in the paint so as to be requested to strongly and continuously stir on the application.

The present pigment may be in any form, for example sphere-, grain-, tear-, flake-like form or the like, or the mixture thereof. The most preferable form is flake-like since the sedimentation speed is slow and the hindering power is also large to surely prevent the film or the steel plate from oxidizing by air or rusting by the corrosive substances in air. And the particle size thereof may be in the range of 0.5 to 1000 microns. To thin and even film, the particle size thereof is preferably not more than 100 microns, more preferably not more than 63 microns, most preferably not more than 44 microns.

The present pigment can be prepared by any known methods. The typical methods for preparing the present pigment are as follows:

- (1) atomizing molten aluminum alloy in an atomization medium such as air or inert gases;
- (2) dropping molten aluminum alloy on a cooled rotary drum or disc; and
- (3) shredding an aluminum alloy foil (or ribbon).

When the pigment having the desired particle size cannot be prepared according to the above-mentioned methods, or the pigment in flake-like form is desired, it is possible to subject the thus-atomized particles or the thus-shredded foil to an additional mechanical grinding in a mill such as a ball mill, an attritor mill, a vibrating mill or the like.

The mechanical grinding is either a dry grinding in the presence of an inert gas or a wet grinding in the presence of a solvent such as mineral spirit using a grinding agent. As the grinding agent, higher fatty acids, higher aliphatic alcohols, higher aliphatic amines and the like can be used. Among them the higher aliphatic amines are preferable to obtain the film which has high hardness and is difficultly peeled after suddenly heated at high temperature. This phenomenon is noticeable especially when the present pigment is incorporated in alkyl silicate as the binder to formulate the paint which is hardened by hydrochloric acid, probably due to that the amine once adhered on the surface of the aluminum alloy particle may be easily desorbed by the function of hydrochloric acid to form a salt and as a result a hydrophobic coating consisting of aliphatic amine adsorbed on the surface of the particle is disappeared to allow the surface of the particle active, thereby the aluminum alloy particles can be tightly bound with the alkyl silicate binder.

The following higher aliphatic amines are exemplified. Capryl amine, lauryl amine, myristyl amine, stearyl amine, oleyl amine, dilauryl amine, distearyl amine, dimethyl octyl amine, d'methyl decyl amine, dimethyl lauryl amine, dimethyl myristyl amine, dimethyl palmityl amine, dimethyl stearyl amine, tricapryl amine, methyl distearyl amine, methyl dilauryl amine and the like, or the mixture thereof.

The used amount of the higher aliphatic amine is controlled to contain the amine in an amount of 0.05 to 3.0 parts by weight per 100 parts by weight of the aluminum alloy particles. When the amine content is less than 0.05 part by weight, the dispersibility of the particles lowers since the particles cohere strongly to each other although the hardness of the film is satisfactory. On the other hand, when the amine content is more than 3.0 parts by weight, the hardness of the film tends to lower and so only the film having low hardness can be obtained although the dispersibility is good.

As mentioned above, the mechanical grinding using the appropriate amount of the higher aliphatic amine as the grinding agent is effective to obtain the film having high hardness.

- After subjecting to the wet grinding, larger or coarser particles are removed by screening through a screen such as a vibrating screen and the like and the solid phase is separated from the liquid phase to form a filter cake with the metal content of 85 to 90 %. In the successive mixing or blending step, the metal content is finally adjusted to the desired extent if necessary by adding suitable additives to obtain the flake-like particles. 5
- Alternatively, after subjecting to the dry grinding, the particles are classified in an inert gas atmosphere to collect the flake-like particles. The mixing or blending step may follow.
- In the mixing or blending step, if necessary, the thus-obtained flake-like particles are mixed with the particles with the particle size of less than 63 microns in the sphere- or tear-like form.
- 10 Moreover, to add a minor amount (for example up to 1.5% by weight) of higher fatty acid acid or higher aliphatic alcohol to the present pigment is effective to lengthen the spot life of the paint. 10
- The present pigment having the excellent anti-corrosive and heat-resisting properties is useful for incorporation in paints such as the shop primer and the heat-resistant paint, and the coating formulations and the like.
- 15 The present pigment is incorporated in a binder to formulate a paint in any known manner. As the binder, any of the known binders for paint can be used. Epoxy resins, alkyd resins, silicone resins are exemplified. The preferable binder is alkyl silicate, alkali silicate and alkyl titanate which are excellent with respect to the heat-resisting property. 15
- The pigment volume concentration of the present pigment in the paint is generally about 20 to 50 % by volume. In case of the pigment comprising the atomized aluminum alloy particles, 30 to 50 % by volume is preferable. And in case of the pigment comprising the ground aluminum alloy particles 20 to 40 % by volume is preferable since oil absorption value is relatively high. 20
- The paint formulated to incorporate the present pigment can be applied in a manner to meet the conditions. For example, an air spray painting, an airless spray painting, a brush coating may be used as the application manner. 25
- Now the present invention will be described by the Examples and Comparative Examples.
- Examples 1 to 10 and Comparative Examples 1 to 9*
- An aluminum alloy having the composition described in Table 1 was prepared according to the air atomization method. The aluminum alloy was screened through a 350 mesh screen to collect the aluminum alloy particles with the particle size of less than 44 microns. The thus-collected particles were used as the pigment incorporated in a paint 30
- In Comparative Example 1, Zinc Powder No. 3[®] (manufac. by Mitsui Mining and Smelting Co., Ltd.) was used as the pigment.
- 35 The paint was formulated by incorporating the thus-prepared pigment in a varnish comprising 50 % by weight of Ethyl Silicate 40[®] (manufac. by Tama Kagaku Kogyo Co., Ltd.), 1 % by weight of a 5 % aqueous hydrochloric acid solution, 43.2 % by weight of isopropyl alcohol and 5.8 % by weight of demineralized water. 35
- The content of the pigment in the paint was adjusted to be 45.8 % by volume based on the specific gravity of the alloy. 40
- The paint so formulated was coated using a brush on a sand blasted steel plate in a size of 70 × 150 × 2.3 mm so as to form a film having a thickness of about 30 microns after drying. The plate was dried at room temperature for four days after coating and then the dried plate was used as a specimen for the following tests. 45
- (1) *Salt spray test:*
- This test was carried out in accordance with JIS K-5400.
- After 300 hours, the conditions of the scratch portions and the total surface of the film were observed by the necked eyes to evaluate the extent of rust.
- 50 This test was carried out before and after the following Heat Test 2. 50
- (2) *Heat tests:*
- First, the specimen was heated in an electric furnace from room temperature to 700°C for about 45 minutes to observe the conditions of film (Heat Test 1).
- 55 Alternatively, the specimen was heated from room temperature to 700°C for about 4 hours, maintained at 700°C for 30 minutes and allowed to cool to room temperature to observe the conditions of film (Heat Test 2). 55
- The results are shown in Table 1.
- In any Examples and Comparative Examples the peelings or cracks of the film were not found when heated slowly as in Heat Test 2.

TABLE 1

Example	Composition (wt %)			Calculated specific gravity	Heat Test 1*1	Salt Spray Test *2	
	Zn	Si	Al			before Heat Test 2	after Heat Test 2
1	26	18	56	3.8	○	○	○
2	30	18	52	4.0	○	○	○
3	40	18	42	4.4	○	○	○
4	50	18	32	4.8	○	○	○
5	26	10	64	3.8	○	○	○
6	40	10	50	4.4	○	○	○
7	50	10	40	4.9	○	○	○
8	26	25	49	3.8	○	○	○
9	40	25	35	4.4	○	○	○
10	50	25	25	4.8	○	○	○
Comparative	-	-	-	-	-	-	-
Example 1	100	-	-	7.1	×	○	×
2	-	-	100	2.7	×	×	×
3	50	-	50	4.9	×	○	×
4	25	-	75	3.8	△	×	×
5	55	18	27	5.1	○	○	×
6	55	25	20	5.0	○	○	×
7	60	10	30	5.3	○	○	×
8	40	30	30	4.3	○	×	×
9	50	30	20	4.8	○	×	×

Note:

*1 ○ peeling of the film was not found;

△ peeling of the film in a diameter of less than 2 cm were found,

× peelings of the film in a diameter of more than 2 cm were found.

*2 ○ rust was not found;

○ a little rust was found in the scratch portions; and

× remarkable rusts were found in the total surface of the film.

Examples 11 to 17 and Comparative Examples 10 to 18

The following experiments were carried out to determine the effect of higher aliphatic amines.

5 An atomized aluminum alloy particles having the composition described in Table 2 were charged in a ball mill containing 50 kg of steel ball with 0.8 ℓ of mineral spirit and a grinding agent to grind until the amount of the residue having the particle size of 63 microns and over after screening through a 250 mesh screen is about 2 %. The grinding time was varied depending on the composition of the aluminum alloy and the used amount of the grinding agent. The charged amount of the aluminum alloy was determined on the basis of the following formula: 5

Amount of atomized aluminum alloy particles (g) = 500 × specific gravity of alloy

10 The ground aluminum alloy particles were washed with 19.2 ℓ of mineral spirit and screened through a 250 mesh screen to prepare a metallic slurry. Then the slurry was filtered with suction to obtain the flake-like aluminum alloy pigment with the metal content of about 80 %. 10

The content of the grinding agent was determined on the basis of the amount extracted with ether - acetone from the aluminum alloy pigment obtained after the filtration with suction.

15 In Comparative Example 10, Zinc Powder No. 3[®] (manufac. by Mitsui Mining and Smelting Co., Ltd.) was used as the pigment. And in Comparative Example 18, the atomized aluminum alloy particles having the particle size of less than 44 microns in which the grinding agent was not containing were used as the pigment. 15

20 The paint was formulated by incorporating the thus-obtained pigment in a varnish comprising 50 % by weight of Ethyl Silicate 40[®] (manufac. by Tama Kagaku Kogyo Co., Ltd.), 1 % by weight of a 5 % aqueous hydrochloric acid solution, 43.2 % by weight of isopropyl alcohol and 5.8 % by weight of demineralized water. 20

The content of the pigment in the paint was adjusted to be 40 % by volume based on the specific gravity of the alloy, provided that in Dispersibility Test the content was adjusted to be 20 % by volume.

25 The thus-obtained paint was used as a specimen for the following tests. 25

(1) *Sedimentation test:*

100 ml of the paint was enough stirred in a measuring cylinder and then allowed to stand for 10 minutes to determine the volume that the pigment was sedimented in the paint (sedimentation volume). 30

(2) *Dispersibility test:*

The pigment was mixed with the above-mentioned varnish to be the pigment concentration of 20 % by volume in a can, stirred for 10 minutes to determine the dispersibility by means of a grind gauge.

35 Further, the paint was coated using a brush on a sand blasted steel plate in a size of 70 × 150 × 2.3 mm so as to form a film. The plate was dried at room temperature for four days after coating and then the dried plate was used as a specimen for the following tests. 35

(3) *Hardness test:*

40 This test was carried out in accordance with JIS K-5400. That is, the film of the specimen was scratched using a pencil lead of difference hardness. 40

(4) *Salt spray test:*

This test was carried out in the same manner as Example 1.

45 (5) *Heat test:* 45

This test was also carried out in the same manner as Heat Test 2 of Example 1.
The results are shown in Table 2.

TABLE 2

	Composition (wt %)			Calculated specific gravity	Grinding agent	Content of grinding agent	Sedimentation volume (ml)
	Zn	Si	Al				
Example 11	30	18	52	4.0	lauryl amine	0.8	4
12	50	18	32	4.8	lauryl amine	0.8	5
13	30	18	52	4.0	lauryl amine	0.07	9
14	30	18	52	4.0	lauryl amine	3.0	4
15	30	18	52	4.0	stearyl amine	2.0	4
16	30	18	52	4.0	dilauryl amine	1.5	4
17	30	18	52	4.0	coconut amine	1.0	4
Compara- tive Example 10	100	-	-	7.1	-	-	31
11	50	-	50	4.9	lauryl amine	1.1	2
12	55	18	27	5.1	lauryl amine	0.8	6
13	40	30	30	4.3	lauryl amine	0.8	5
14	30	18	52	4.0	oleic acid	0.8	4
15	30	18	52	4.0	stearic acid	0.8	4
16	30	18	52	4.0	lauryl amine	0.03	10
17	30	18	52	4.0	lauryl amine	3.5	4
18	30	18	52	4.0	-	-	20

TABLE 2 (cont'd)

5		Dispersibility ^{*1}	Hardness ^{*2}	Salt Spray Test ^{*3}		5
				before Heat Test	after Heat Test	
	Example 11	○	2H	◎	◎	
	12	○	2H	◎	◎	
10	13	△	2H	◎	◎	10
	14	○	2H	◎	◎	
	15	○	2H	◎	◎	
	16	○	2H	◎	◎	
	17	○	2H	◎	◎	
15	Comparative Example 10	○	2H	◎	×	15
	11	○	2H	○	×	
20	12	○	2H	◎	×	20
	13	○	2H	×	×	
	14	○	6B	○	○	
	15	○	6B	○	○	
	16	×	2H	◎	◎	
25	17	○	B	◎	◎	25
	18	○	2H	◎	◎	

Notes:

^{*1} ○ --- the particles with the particle size of not more than 60 microns were observed; 30

△ --- the particles with the particle size from over 60 to less than 70 microns were observed; and

× --- the particles with the particle size of more than 70 microns were observed.

^{*2} 6B is the most soft and 9H is the most hard in the hardness of the pencil lead.

^{*3} please see note 2 in Table 1. 35

35 **Examples 18 to 28 and Comparative Examples 19 to 23**

The following experiments were carried out to determine the effect of the addition of indium and/or tin.

40 An aluminum alloy having the composition described in Table 3 was prepared according to the air atomization method. The aluminum alloy was screened through a 350 mesh screen to collect the aluminum alloy particles with the particle size of less than 44 microns. The thus-collected particles were used as the pigment incorporated in a paint. 40

In Comparative Example 19, Powder No. 3[®] (manufac. by Mitsui Mining and Smelting Co., Ltd.) was used as the pigment.

45 In Examples 27 and 28 and Comparative Example 23, the atomized aluminum alloy particles after screening through a 100 mesh screen were ground in a ball mill in the presence of mineral spirit and lauryl amine as the grinding agent followed by screening through a 250 mesh screen to collect the aluminum alloy particles with the particle size of less than 63 microns, which were used as the pigment. 45

50 The paint was formulated by incorporating the thus-prepared pigment in a varnish comprising 50 % by weight of Ethyl Silicate 40[®] (manufac. by Tama Kagaku Kogyo Co., Ltd.), 1 % by weight of a 5 % aqueous hydrochloric acid solution, 43.2 % by weight of isopropyl alcohol and 5.8 % by weight of demineralized water. 50

The content of the pigment in the paint was adjusted to be 40 % by volume based on the specific gravity of the alloy.

55 The paint so formulated was coated using a brush on a sand blasted steel in a size of 70 × 150 × 2.3 mm so as to form a film. The plate was dried at room temperature for four days after coating and then the dried plate was used specimen for the following test. 55

(1) *Salt spray test:*

This test was carried out in accordance with JIS K-5400.

60 After 300 hours, the conditions of the scratch portions and the total surface of the film were observed by the necked eyes to evaluate the extent of rust. 60

This test was carried out before and after the following Heat Test.

(2) *Heat test:*

65 The specimen was heated from room temperature to 800°C for 2 hours, maintained at 800°C for 30 minutes 65

and allowed to cool to room temperature to observe the conditions of film.
The results are shown in Table 3.

TABLE 3

Example	Composition (wt %)					Calculated specific gravity	Heat Test *1	Salt Spray Test *2	
	Zn	Si	In	Sn				before Heat Test	after Heat Test
18	30	15	0.05	-	-	4.0	○	○	○
19	50	15	0.05	-	-	4.8	○	○	○
20	40	25	0.02	-	-	4.4	○	○	○
21	30	15	0.01	-	-	4.0	○	○	○
22	30	15	0.20	-	-	4.0	○	○	○
23	30	20	-	0.01	-	4.0	○	○	○
24	30	15	-	0.50	-	4.0	○	○	○
25	30	15	-	2.0	-	4.1	○	○	○
26	30	10	0.05	0.50	-	4.0	○	○	○
27	30	15	0.05	-	-	4.0	○	○	○
28	30	15	-	0.50	-	4.0	○	○	○
Comparative Example 19	100	-	-	-	-	7.1	×	○	×
20	30	15	-	-	-	4.0	○	○	×
21	5	-	0.02	-	-	2.9	○	×	×
22	5	-	-	0.50	-	2.9	○	×	×
23	50	-	0.05	-	-	4.9	×	○	×

Note:

*1 please see Note 1 in Table 1.

*2 please see Note 2 in Table 1.

CLAIMS

1. An aluminum alloy containing
 (i) more than 25 to 50% by weight of zinc,
 5 (ii) from 10 to 25% by weight of silicon, 5
 (iii) optionally from 0.01 to 0.2% by weight of indium and/or from 0.01 to 2.0% by weight of tin, and
 (iv) the balance being aluminum and impurities.
2. An alloy according to claim 1, wherein the zinc content is from 30 to 40% by weight.
3. An alloy according to claim 1 or 2, wherein the silicon content is from 12 to 20% by weight.
- 10 4. An aluminum alloy substantially as hereinbefore described in any one of Examples 1 to 28. 10
5. A pigment suitable for use in a paint for use to protect a steel surface from rusting and/or heat, which pigment comprises an aluminum alloy as claimed in any one of the preceding claims.
6. A pigment according to claim 5, which further comprises from 0.05 to 3.0 parts by weight of higher aliphatic amine per 100 parts by weight of the aluminum alloy.
- 15 7. A pigment according to claim 6, wherein the higher aliphatic amine is capryl amine, lauryl amine, 15
 myristyl amine, stearyl amine, oleyl amine, dilauryl amine, distearyl amine, dimethyl octyl amine, dimethyl decyl amine, dimethyl lauryl amine, dimethyl myristyl amine, dimethyl palmityl amine, dimethyl stearyl amine, tricapryl amine, methyl distearyl amine or methyl dilauryl amine, or two or more thereof.
8. A pigment according to any one of claim 5 to 7, which further comprises a minor amount of higher
 20 aliphatic alcohol or higher fatty acid. 20
9. A pigment substantially as hereinbefore described in any one of Examples 1 to 28.
10. A process for the preparation of a pigment as claimed in claim 5, which process comprises
 (A) (1) atomizing an aluminum alloy as defined in claim 1 when molten, or
 (2) dropping the said aluminum alloy when molten onto a cooled rotating drum or disc, or
 25 (3) shredding foil or ribbon composed of the said aluminum alloy; and, optionally, 25
 (B) mechanically grinding the thus-prepared pigment particles.
11. A process according to claim 10, wherein in step (B) mechanical grinding is effected in the presence of one or more higher aliphatic amine.
12. A process according to claim 11, wherein the higher aliphatic amine is capryl amine, lauryl amine,
 30 myristyl amine, stearyl amine, oleyl amine, dilauryl amine, distearyl amine, dimethyl octyl amine, dimethyl 30
 decyl amine, dimethyl lauryl amine, dimethyl myristyl amine, dimethyl palmityl amine, dimethyl stearyl amine, tricapryl amine, methyl distearyl amine or methyl dilauryl amine, or two or more thereof.
13. A process according to claim 11 or 12, wherein the amount of higher aliphatic is controlled so that the pigment particles that are obtained contain from 0.05 to 3.0 parts of higher aliphatic amine per 100 parts by
 35 weight of the said aluminum alloy. 35
14. A process for the preparation of a pigment, said process being substantially as hereinbefore described in any one of Examples 1 to 28.
15. A paint suitable for use to protect a steel surface from rusting and/or from heat, which paint comprises a pigment as claimed in any one of claims 5 to 9 or which has been prepared by a process as
 40 claimed in any one of claims 10 to 14 and a binder. 40
16. A paint according to claim 15 comprising from 20 to 40% by weight of a pigment as claimed in any one of claims 6 to 8.
17. A paint suitable for use to protect a steel surface from rusting and/or from heat, said paint being substantially as hereinbefore described in any one of Examples 1 to 28.
- 45 18. A method of protecting a steel surface from rust and/or from heat, which method comprises applying 45
 to the surface a paint as claimed in any one of claims 15 to 17.
19. A method of protecting a steel surface from rust and/or from heat, said method being substantially as hereinbefore described in any one of Example 1 to 28.