May 22, 1945. G. GAUTHIER 2,376,681

ALUMINUM BASE ALLOY WITH PROTECTIVE COATING

Filed Feb. 1, 1941

FIG. 1.

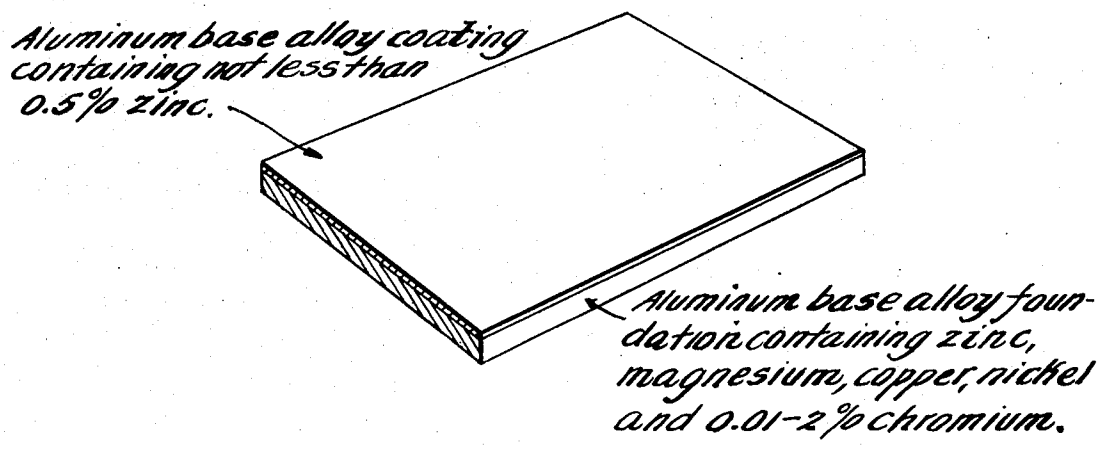
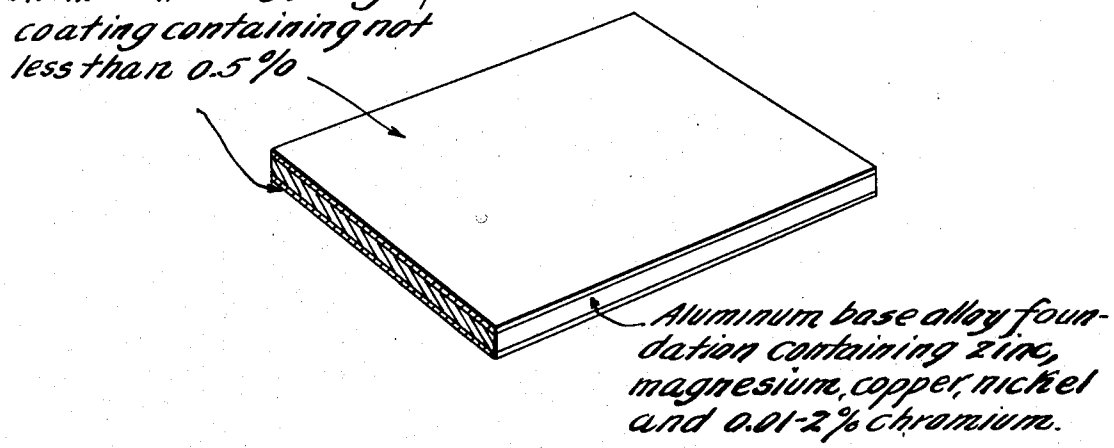


FIG. 2.



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ALUMINUM BASE ALLOY WITH PROTECTIVE COATING

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Application February 1, 1941, Serial No. 377,048
In France January 26, 1940

1 Claim. (Cl. 29—181)

It is known that one of the means by which a metal, subjected either to a corrosive medium, or simply to weather conditions, is protected from corrosion, consists in covering it with a plating constituted by a metal less precious than itself. It is thus that the protection of iron is obtained by zinc for galvanized sheet metal plates and the protection of duralumin by aluminum for "Vedal" and "alclad." The choice of the protecting materials to be used is often difficult. Such is the case in particular for the protection of certain aluminum alloys the composition limits of which are:

	Per cent
Zn	up to 15
Mg	up to 7
Cu	up to 5
Ni	up to 3
Cr	0.01 to 2
Al	Substantially the remainder

and can moreover contain certain known additions for rendering the grain finer and improving the plasticity, such as: V, Ti, Zr, Mn, etc. These alloys have very high grade characteristics but present the inconvenience of being rather sensitive to corrosion.

The applicant has noticed the suprising fact that a layer of plating, constituted by an aluminum alloy containing zinc, ensured the protection; the zinc content must be higher than 0.5%.

Either in order to facilitate the intimate welding of the layer of plating with the alloy member to be protected, or to modify in a definite direction the diffusion between the layers of the alloy elements during the heat treatment, or for any other reason, a layer of metal or alloy, of different composition than that of both alloys, for instance, a layer of aluminum of chosen purity, may be interposed between the layer of plating and the foundation metal.

In the layer of aluminum-zinc alloy can advantageously be incorporated all the known elements for promoting the obtainment or the maintenance of a fine grain during the manufacture (melting, casting), heat treatments and mechanical distortions, such as small quantities of V, Ti, Zr, Mn, etc., together or separately but in total quantities smaller than 2%.

The elements entering into the composition of the protecting layer above defined could be the usual metals found on the market or, if a marked incorrodibility of the layer is to be ensured, use will be made of the purest metals, so-called "refined metals," that is to say of very low content in impurities, titrating more than 99.90%.

The plating layer of alloy of the above specified composition, can be plated on the ingots or members at any one of the phases of manufacture: it can be plated either before any transforming operation, or after the various transforming operations (extrusion, forging, rolling, etc.) or on the semi-finished products between certain transforming operations.

Referring to the drawing, Fig. 1 shows a sheet of metal with plating on one side and Fig. 2 with the plating on both sides.

The protection process applies not only to the manufacture of members obtained by mechanical transformation processes (extrusion, forging, rolling, etc.) which utilise either ingots, or semi-finished products, but also applies to the case of foundry members, that is to say, to cast members used after more or less complex machining (fettling, drilling, milling, etc.).

The plating metal may be cast or welded to the foundation metal by any of the well-known casting or welding processes.

The protecting alloy layer of the composition specified can also be secured by atomizing by a known process said protecting metal either at the surface of a cast ingot adapted to be transformed by one of the known means (extrusion, forging, stamping, etc.), or at the surface of members adapted to be used such as they come from casting, or again, at the surface of blanks adapted to be subjected to a complementary transforming operation by a known process (extrusion, forging, rolling, etc.), or at the surface of finished members obtained by known processes (extrusion, forging, rolling, etc.).

The protecting layer of the composition specified can also be produced by an electrolytic process, or by a chemical process such as surface precipitation or cementation, that is to say by a modification of the composition of the superficial part of the ingot by the action of salts, metals, alloys, intermetallic compounds or mixtures of these various bodies. These modifications can be effected on the ingots, sand-cast or chill-cast members, finished or semi-finished products.

Said cementation can consist, as usual, in increasing the content of the surface layer in certain elements (Zn, for instance), or in diminishing the content in certain other elements (Mg for instance), or by evaporation (eventually during the heat treatment), or by oxidation (by tempering in a bath which can be an oxidizing molten bath such as potassium bichromate), or by any other reaction with a gaseous atmosphere, a liquid or solid salt, an alloy, or a suitable mixture of these bodies.

The plated members, finished or semi-finished products obtained can be subjected to ameliorating heat treatments suited to the foundation alloy. Said treatments have been described in the United States Patent application Serial No. 377,047 filed on the same day as the present, for "Improvements in aluminum alloys." (This treatment, briefly stated, consists essentially in subjecting the alloy to a "dissolving" temperature between 350° C. and melting temperature, then suddenly cooling, and finally subjecting the alloy to a "precipitating" treatment by heating to a temperature up to 400° C.) The dissolving treatment could eventually be prolonged until nearly complete homogenisation of the plating layer and the foundation metal, or of the plating layer, the intermediate layer and the foundation metal, or of the intermediate layer and of one of the two other layers, if necessary for ensuring the suitable cohesion of the layers one to the other, for instance in view of important plastic or non-plastic distortions to which the member thus treated is to be subsequently subjected; or again for increasing the average mechanical characteristics of the compound product.

For simply illustrating the efficiency of the process as regards protection against corrosion, by way of example, the following experiment will be cited:

A sheet metal plate 1 m./m. thick was prepared with an aluminum base alloy having the composition:

Mg 2.65—Cu 1.44—Zn 8.27—Cr 0.24—Fe and Si: impurities, as well as another sheet metal plate of the same alloy, but plated on each face with an alloy having 4% of Zn.

After heat treatment, the characteristics were:

1st metal plate:
- Before corrosion—
  - Tensile strength kg./mm.^{2}=62.6
  - Elastic limit kg./mm.^{2}=56.3
  - Elongation, per cent=16.6
- After 6 months corrosion in a salt mist—
  - Tensile strength kg./mm.^{2}=30.4
  - Elastic limit kg./mm.^{2}=30.2
  - Elongation, per cent=5

2d metal plate:
- Before corrosion—
  - Tensile strength kg./mm.^{2}=60.4
  - Elastic limit kg./mm.^{2}=53.5
  - Elongation, per cent=14
- After 6 months corrosion in a salt mist—
  - Tensile strength kg./mm.^{2}=56.3
  - Elastic limit kg./mm.^{2}=50
  - Elongation, per cent=10.3

In his copending application Serial No. 377,049, filed on even date herewith, Patent No. 2,354,006, applicant discloses and claims the protection of an aluminum alloy which contains up to 15% Zn, up to 7% Mg, up to 5% Cu, and up to 3% Ni, by means of a layer of an aluminum-zinc alloy which contains more than 0.5% Zn.

What I claim is:

An aluminum base alloy, comprising a foundation member of the known type that has a propensity to undergo cracking intercrystalline corrosion, containing substantial quantities of zinc up to 15%, magnesium up to 7% and copper up to 5% and nickel up to 3% and chromium from 0.01 to 2%, respectively, an adherent coating thereon comprising an aluminum base alloy containing a quantity of zinc in an amount of the order of 0.5–4% but not less than 0.5%.

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