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METHOD OF PRODUCING INDICIA-BEARING SURFACES

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2 Claims. (Cl. 96—36)

This application is a continuation of our prior copending application Ser. No. 123,090 filed July 11, 1961, now abandoned.

The present invention relates to a novel and improved method for the production of indicia-bearing metal surface, such as name-plates, instrument panels, decorative plaques, and similar surfaces in which there is a design formed on the surface in a color contrasting with the color of the base metal.

The present invention has for its object the provision of a simple, rapid and economical process for the preparation of indicia-bearing metal surfaces, especially on plaques, panels and other surfaces of magnesium and magnesium-based alloys. A further object of the invention is the provision of a novel and improved process which produces high-quality indicia-bearing surfaces in a relatively inexpensive manner, even in small quantities. Still another object is the provision of a novel and improved process in which the surface of a magnesium or other metal surface may be provided with a pigmented layer in the form of an indicia-bearing or decorative design, by etching portions of the pigmented layer from the surface of the metal.

In general, the process of the present invention comprises subjecting the clean metal surface, preferably of a magnesium or magnesium-based alloy, to a chrome pickling bath to render the surface oxidation-resistant. Thereafter, the surface is dried and coated with a pigmented lacquer which is capable of being attacked, disintegrated and removed by a bath of a strong oxidizing acid, such as hot chromic acid. The lacquered surface is then dried and is coated with a layer of a photosensitive resist which can be rendered insoluble by exposure to light, and which will provide areas which are resistant to the action of the hot chromic acid or other strong oxidizing bath. The photosensitive resist layer, after drying, is subjected to the required degree of exposure through a negative of the design to be reproduced on the metal surface, and is developed in an appropriate developer to uncover areas of the pigmented lacquer surface. The plate or other object is then immersed in the strong oxidizing bath, preferably hot chromic acid for a short period of time, until the lacquer has been attacked and completely removed from the areas where it has not been protected against the action of the oxidizing bath, after which the plate is immersed in a bath of nitric or other suitable acid to clean the unprotected areas of the metal plate, so as to leave the unprotected areas bright and clean. The plate is then rinsed with water, dried and coated with a suitable lacquer to protect it against oxidation or other corrosion.

Referring now in detail to the present preferred method of the present invention:

A sheet or plate of magnesium metal or a magnesium based-alloy, usually having a smooth flat surface is coated with an adherent primer coating, such as is provided by treating the metal surface with a chrome pickle bath, such as Dow #1 chrome pickle bath, which may be replaced by an aqueous bath comprising 24 ounces sodium dichromate and 16 to 24 ounces concentrated nitric acid per gallon. Before pickling, the surface of the metal should be cleaned if necessary, as by treatment with trichloroethane, trichloroethylene, or other effective degreasing solvent, or by vapor degreasing with a solvent such as trichloroethylene.

The pickled sheet is then rinsed with water, dried and coated with a uniform coating of an opaque pigmented lacquer or paint which is capable of being attacked and removed by immersion in hot chromic acid or other strong oxidizing bath. Among the many suitable lacquers are the epoxy resin lacquers and tung oil-phenolic resin lacquers; and Metal and Thermit Company's epoxy resin lacquer "AP–10" is preferred. Any suitable permanent pigment may be used in the lacquer, such as a black, red or green pigment, depending upon the color desired in the finished surface. The lacquer coating is thoroughly dried, and is then preferably cleaned with an organic liquid which does not substantially attack the lacquer surface, such as toluene, trichloroethane, trichloroethylene or a mixture of such liquids. Preferably, a mixture of 75% trichloroethylene and 25% trichloroethane is employed.

The lacquered surface of the metal is then provided with a uniform thin coating of a photosensitive resist which will produce, after exposure to light and development, areas adherent on the lacquer surface which areas are insoluble in water and are also substantially resistant to hot chromic acid. Among the preferred photosensitive resists are Kodak Photo Resist ("KPR") and Chemco Photoproducts "Vyna-Top."

Kodak Photo Resist ("KPR"), an all-plastic, presensitized, liquid surface coating, which when dried provides a waterproof, acid-resistant and alkali-resistant coating, is applied to the surface of the metal plate or sheet by conventional whirler-coating technique, by pouring, or by spraying, after which it is dried in a current of warm air, such as it usually provided in the plate whirling machine. Kodak Photo Resist is a hypersensitized cinnamoyl ester of polyvinyl alcohol, which on exposure to light is rendered resistant to the action of chromic acid, and is then substantially insoluble in water, trichloroethylene, trichloroethane, toluene and other usual organic solvents. Such resists are disclosed in various patents of Eastman Kodak Company such as Nos. 2,610,120, 2,666,701, 2,670,285, 2,670,286, 2,670,287, 2,690,966, 2,691,584, 2,697,039, 2,725,372, 2,732,297 and 2,732,301.

Chemco "Vyna-Top" is a polyvinyl alcohol solution sensitized with a chromic acid salt, which after coating and drying may be rendered water insoluble and substantially insoluble in trichloroethane, trichloroethylene, toluene and mixtures thereof, and is substantially resistant to hot aqueous solutions of chromic acid. Like KPR it may be applied to the surface of the metal plate by conventional whirler-coating techniques, by pouring, or by spraying, followed by drying at moderate temperatures in circulating air.

The coated metal plate or sheet is exposed to intense light through a "negative" which may have been produced photographically or otherwise and comprises opaque and transparent areas in the form of lettering or other designs, the transparent areas corresponding to those portions which are to appear as pigmented areas on the metal surface in the finished article.

With the negative held in firm, intimate contact with the photosensitive resist layer on the metal plate, as in a vacuum printing frame, the areas of the photosensitive resist under the transparent areas are exposed for a period of less than about 1 to as much as a few minutes to an intense light source, such as a 110 amp. arc light spaced from 3 to 4 feet away from the negative and resist layer.

The exposed photosensitive resist layer is developed in the appropriate developer. When using KPR, it is immersed in KPR developer, or in a bath of trichloroethylene, after which it is washed thoroughly in water. If Chemco "Vyna-Top" is used at the photosensitive resist,

it is developed to remove the soluble, unexposed portions of the resist, may then be dyed by immersion in a dye solution, after which the resist is hardened by immersion for a few seconds in an 8% to 10% aqueous solution of chromic acid, rinsed and dried.

The metal plate with its pigmented lacquer coating and developed photosensitive resist layer are then preferably subjected to baking at a temperature of about 300° to 350° F. for about 5 to 10 minutes to thoroughly harden the resist and improve its resistance to the action of hot chromic acid.

The developed plate is then etched in a hot chromic acid bath, preferably a 10 to 15% aqueous solution of chromic acid, at a temperature which is preferably from about 190° to 200° F. Most preferably, the chromic acid bath comprises from 20 to 24 ounces of chromic oxide dissolved in each gallon of water. After about a few minutes of immersion in the chromic acid bath, the unprotected areas of the pigmented lacquer layer have been disintegrated and removed from the surface of the metal thereby revealing the underlying metal surface in those areas corresponding to the opaque areas of the negative.

The plate is rinsed in running water, and is then immersed in a dilute solution of nitric acid, such as is formed by diluting one part of concentrated nitric acid with two to four parts of water, and preferably with three parts of water. Other acids than nitric acid may be used, so long as they do not form a smutty layer on the surface of the metal; and for this purpose dilute hydrochloric acid may be used.

The plate is again rinsed, and the remainder of the photosensitive resist layer is then removed as by immersing the plate in a solvent for the exposed resist, such as xylene. Very light friction may also be used to insure thorough removal of the resist, and for this purpose one may use a small pad of fabric or cotton wool wet with xylene or other appropriate solvent.

When the exposed, hardened resist has been fully removed, the plate is again washed and dried, and is then preferably coated with a layer of lacquer, as by spraying. A wide variety of lacquers are suitable to prevent corrosion or dulling of the exposed metal surface, but a coating of a clear epoxy lacquer is preferred, and its application is preferably followed by baking the otherwise completed metal plate at a temperature of about 350° F. for about one-half hour.

The process is also applicable to metal plates and sheets of other materials than magnesium and its alloys, and may be applied to such metals as aluminum, aluminum alloys and stainless steel.

Where aluminum is used, the brightening with nitric acid is omitted and a short immersion in a bath of dilute hydrochloric acid may be substituted for the dilute nitric acid treatment.

The invention in its broader aspects is not limited to the specific steps, processes and compositions shown and described but departures may be made therefrom within the scope of the accompanying claims without departing from the principles of the invention and without sacrificing its chief advantages.

What is claimed is:

1. A process of preparing an indicia-bearing metal surface selected from the group consisting of magnesium, magnesium alloys, aluminum, aluminum alloys and stainless steel, which comprises coating a clean metal surface with a layer of a contrasting colored pigmented lacquer subject to disintegration and removal by a hot chromic acid bath, drying the lacquer layer, cleaning the lacquer layer with a volatile organic liquid which does not attack the lacquer surface, coating the lacquer layer with a photosensitive layer, exposing portions of the photosensitive layer, developing the photosensitive layer to remove the unexposed portions thereof to provide both resistant and unprotected areas overlying the lacquer layer, baking to harden the resist layer, subjecting the lacquer and resist to a hot aqueous solution of chromic acid until the pigmented lacquer layer not covered by the resist is disintegrated and removed, rinsing in water, brightening the unprotected metal areas by treatment with a dilute water solution of nitric or hydrochloric acid, rinsing in water, removing the exposed, hardened areas of resist by means of a solvent for the resist, washing the metal and coating the dried lacquer surface with a coat of a clear protective lacquer.

2. A process according to claim 1 in which the metal is magnesium.

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