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**(54) Improvement in the surface finishing method for aesthetical component parts of transportation means**

(57) Improved method for applying coatings, generally known as "metallized" surface finishes, on to component parts adapted to be used as decorative or aesthetical parts on outer surfaces of transportation means, such as radiator grilles for motor cars. A prior-art process calls for, after the application of corrosion-inhibiting metal layers, the application, again by a galvanic process, of a metal layer adapted to impart the desired combination of colour and brightness, such as for instance a so-called "gun barrel" finish. The present invention provides for the addition of a galvanic chromium-plating phase followed by a phase in which the part is held at a temperature not in excess of 30°C for at least 24 hours, and then by a further phase in which the same chromium layer is removed and the more external layer of corrosion-inhibiting metal is activated in a traditional manner.

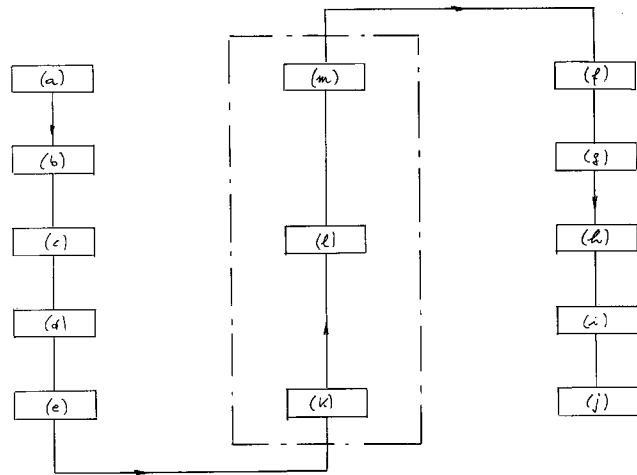


FIG. 1

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## Description

The present invention refers to the methods that are used to apply a "metallized" finish to component parts made of plastic material, which are adapted to be mounted on outer decorative surfaces of transportation means, incl. not only motor vehicles such as cars, but also motor cycles, boats and aircraft.

Plastic material are largely known to be by now widely used to manufacture component parts of the above cited kind, even those that are quite complicated in their shape or design, which require a land of surface finish which must not only be particularly attractive, especially in connection with their use in top-of-range models, but must also be capable of ensuring long-term durability by appropriately withstanding the most critical and severe ambient conditions (high temperatures, marine ambient, corrosion due to salt and/or sand strewn over the road surface in winter to limit the effects of ice formation). For instance, in the manufacturing of component parts that are "metallized" decorative parts of motor vehicles, use is made quite frequently of polymer alloys, such as for instance an ABS-PC alloy (Acrylonitrile-Butadiene-Styrene and Polycarbonates). After injection moulding, such component parts are caused to undergo a finishing process consisting in applying layers of metal materials that are capable of conferring a special combination of colour and brightness (ie. the so-called "metallization") to the decorative surfaces thereof. Particularly appreciated is currently the so-called "gun barrel" finish that calls for the application by galvanic methods, onto the surfaces of such a kind of parts, of at least a layer of metal material to impart said "metallization" effect, the need arising then to protect said layer by means of successive layers of a clear lacquer in view of conferring long-term resistance to the afore mentioned most severe ambient conditions.

For instance, a largely known surface finish process (see Figure 1) for radiator grilles of motor vehicles includes following sequence of phases that are carried out after the phase(a) in which the part is injection-moulded:

- (b) - chemical metallization of the moulded part,
- (c,d,e) - multi-stage galvanization under successive deposition of layers of at least a first and a second metal having a different electrochemical potential,
- (f) - activation of said second metal, for instance with a sodium hydroxide solution,
- (g) - application by galvanic process of a layer of a 60%-40% nickel-tin alloy that is capable of conferring the grille the desired "gun barrel" finish,
- (h) - heat treatment to eliminate residual metal stresses from the mass of polymer alloy,
- (i,j) - application of at least a layer of protective clear lacquer.

Such a process is subject to a number of con-

straints, especially when it is used in connection with large-scale industrial productions. It is first of all absolutely necessary for all of the above mentioned phases to be carried out and completed within as short as possible periods of time in order to ensure due qualitative consistency. This practically requires that, before starting a prolonged period of production shutdown, eg. before closing down the works for summer vacations, no parts (grilles) be left in the warehouse if they have not gone through the whole set of the afore cited phases of their surface finish process. Furthermore, it is not possible, as it would on the contrary be sometimes desirable, for different phases of the process to be carried out in different manufacturing sites (which may be particularly well-equipped to that purpose from a technological point of view and/or may be capable of operating under full compliance with environmental safeguard regulations).

The Applicant has surprisingly found that an interval of time, even a prolonged one, before activating said second corrosion-proof metal layer may actually produce an improvement in the quality of the subsequent galvanic application of the metal layer capable of providing the part with the desired surface finish (ie. the layer of 60%-40% nickel-tin alloy in the considered case of a "gun barrel" finish). Such a result is conditional to some additional phases being introduced in the finishing process, as recited in the appended claims. In this way, the afore mentioned constraints that lie so heavy on the currently used process are practically done away with.

Such a surprising effect and the characteristics of the present invention will be more clearly and readily understood from the description that is given below by way of non-limiting example in connection with the production of a grille for automotive applications and with reference to the accompanying drawings, in which:

- Figure 1 is a flow-chart of the surface finishing process inclusive of the above cited improvements;
- Figure 2 is a schematical, cross-sectional view of an automotive grille at the end of a surface finishing process that includes, as intermediate phases, the improving phases according to the present invention;
- Figure 3 is a schematical, cross-sectional view of the same automotive grille during the execution of the same improving phases according to the present invention.

As schematically illustrated in Figure 2, the cross-section of an automotive grille appears to be constituted, from the inside outwards, by layers of different materials that are described below in the correct order in which they are applied through the various phases of the process that are summarized in the flow chart appearing in Figure 1.

- The reference numeral 1 is used to generally indicate the structure of the grille for automotive applications, which is manufactured by injection moulding starting from a ABS-PC polymer blend, eg. Bayer's "Babyblend T45", in the phase (a);
- the reference numeral 2 is used to indicate a layer of nickel having a thickness of approx. 3  $\mu\text{m}$ ; such a layer is applied chemically, ie. by dipping, in the phase (b) onto the above cited structure in order to make the surface thereof electrically conductive and, as a result, to allow for the subsequent metal layers to be deposited galvanically in the phases from (c) to (g) as described below;
- the reference numeral 3 is used to indicate a layer of a first corrosion inhibiting metal, preferably copper, with a thickness in the order of 25  $\mu\text{m}$ , obtained in the phase (c);
- the reference numeral 4 is used to indicate a first layer of a second corrosion-inhibiting metal having a different electrochemical potential as compared to the first one, obtained in the phase (d); preferably use is made here of columnar-type, semiglossy nickel applied to a thickness in the order of 10  $\mu\text{m}$ ;
- the reference numeral 5 is used to indicate a second layer of said second corrosion-inhibiting metal, which however is of a different type, obtained in the phase (e); more precisely, use is made here of lamellar-type glossy nickel applied to a thickness in the order of 5  $\mu\text{m}$ , which, as for the columnar-type nickel of the layer 4, is activated in the subsequent phase (f) in view of obtaining a good adhesion of the final metal layer, as described below;
- the reference numeral 6 indicates the layer which, obtained in the phase (g), is capable of conferring the grille its "metallized" outlook, ie. the so-called "gun barrel" finish; use is made here of a layer of 60%-40% nickel-tin alloy, applied to a thickness of, say, approx. 1  $\mu\text{m}$ ;
- the reference numeral 7 indicates a layer of acrylic-base clear lacquer primer having a thickness of, say., approx. 15  $\mu\text{m}$ , which is applied by spraying in the phase (i);
- the reference numeral 8 indicates a final layer of a polyurethane-based clear lacquer having a thickness of, say, approx. 25  $\mu\text{m}$ , which is also applied by spraying in the phase (j).

The additional phases according to the present invention, which are carried out in the order given below, and which are shown enclosed in an area delimited by a chain-like line in the flow chart of Figure 1, are:

(k) - galvanic deposit of a layer of chromium, indicated at 10 in Figure 3, to a thickness in the order of 0.3  $\mu\text{m}$  over the above mentioned layer 5 of activated metal (practically, over the lamellar-type nickel); the cross-sectional view of the grille shown in Figure 3 is referring precisely to this phase; the deposit of chromium has essentially the purpose of protecting the grille from those environmental damages which can affect the quality thereof (visual aspect) in the subsequent phase in which

(l) - the part (ie. the grille) is kept for at least 24 hours without any mechanical stress at an ambient temperature, which shall however not exceed approx. 30°C, in view of enabling the layers 3, 4 and 5 of corrosion-inhibiting metals to more effectively cling, ie. adhere;

(m) - removal of the same chromium layer immediately before starting the activation of the layers 4 and 5 of corrosion-inhibiting nickel during the already cited phase (f).

As anyone skilled in the art is able to appreciate, a visual inspection (eg. under the microscope) of a cross section of the finished grille will not reveal whether the finishing process it went through actually included the above mentioned additional phases. As a matter of fact, the invention has essentially the advantage of enhancing the uniformity of the subsequent deposit of the layer that brings about the "metallization" of the part (ie. the 60%-40% nickel-tin alloy) when said deposit is made on an industrial scale. In other words, the present invention has the advantage of reducing production rejects and scraps, ensures that the chromatic, ie. decorative effects of the "metallization" do not undergo any alteration or change in the course of time, and finally improves the durability characteristics of the so finished parts. This particular advantage of an improved durability is demonstrated by the fact that automotive grilles produced by the Applicant in accordance with the present invention unfailingly pass the 72-hour Cass Test, the Florida Test and the test in the humidostatic chamber.

Although the method according to the present invention has been described with reference to a "gun-barrel metallization" finishing application, it will be readily appreciated that further applications may be developed by those skilled in the art without departing from the scope of the present invention. In particular, the "metallizing" layer may be constituted by other metals, such as for instance ruthenium. It will be also appreciated that the invention is valid and applies regardless of the manner in which the traditional phases of the finishing process are carried out, eg. the final painting or lacquering phases (i) and (j) may be carried out with an electrophoretic method instead of an electrostatic one.

## Claims

1. Method for applying a "metallized" surface finish to component parts made of plastic material, which are adapted to be mounted on outer decorative surfaces of transportation means, such as automotive vehicles and motor cycles, comprising the phases of: 5
- chemical metallization of the plastic material, 10
  - galvanization with successive deposit of layers of at least two corrosion-inhibiting metals having a different electrochemical potential,
  - activation of the outer layer of corrosion-inhibiting metal, 15
  - application of the metal layer adapted to confer the desired aesthetical finish to the part,
  - heat treatment to remove stresses,
  - coating with at least a layer of clear lacquer to the purpose of protecting the above cited aesthetical finish, 20
- characterized in that** following phases are carried out successively between the above cited phases of deposit of corrosion-inhibiting metals and activation of the same metals: 25
- galvanization under deposition of a chromium layer,
  - storage of the part at ambient temperature, anyway not in excess of 30°C, for a period of time not shorter than approx. 24 hours; 30
  - removal of said chromium layer.
2. Method according to claim 1, **characterized in that** during said phase in which the part is so kept at ambient temperature, said part is not exposed to any mechanical stress. 35
3. Component part for automotive vehicles, motor bikes and the like, adapted to be mounted on an outer surface thereof, made of plastic material and **characterized in that** it is provided with a surface finish obtained with the method according to claim 1 or 2. 40

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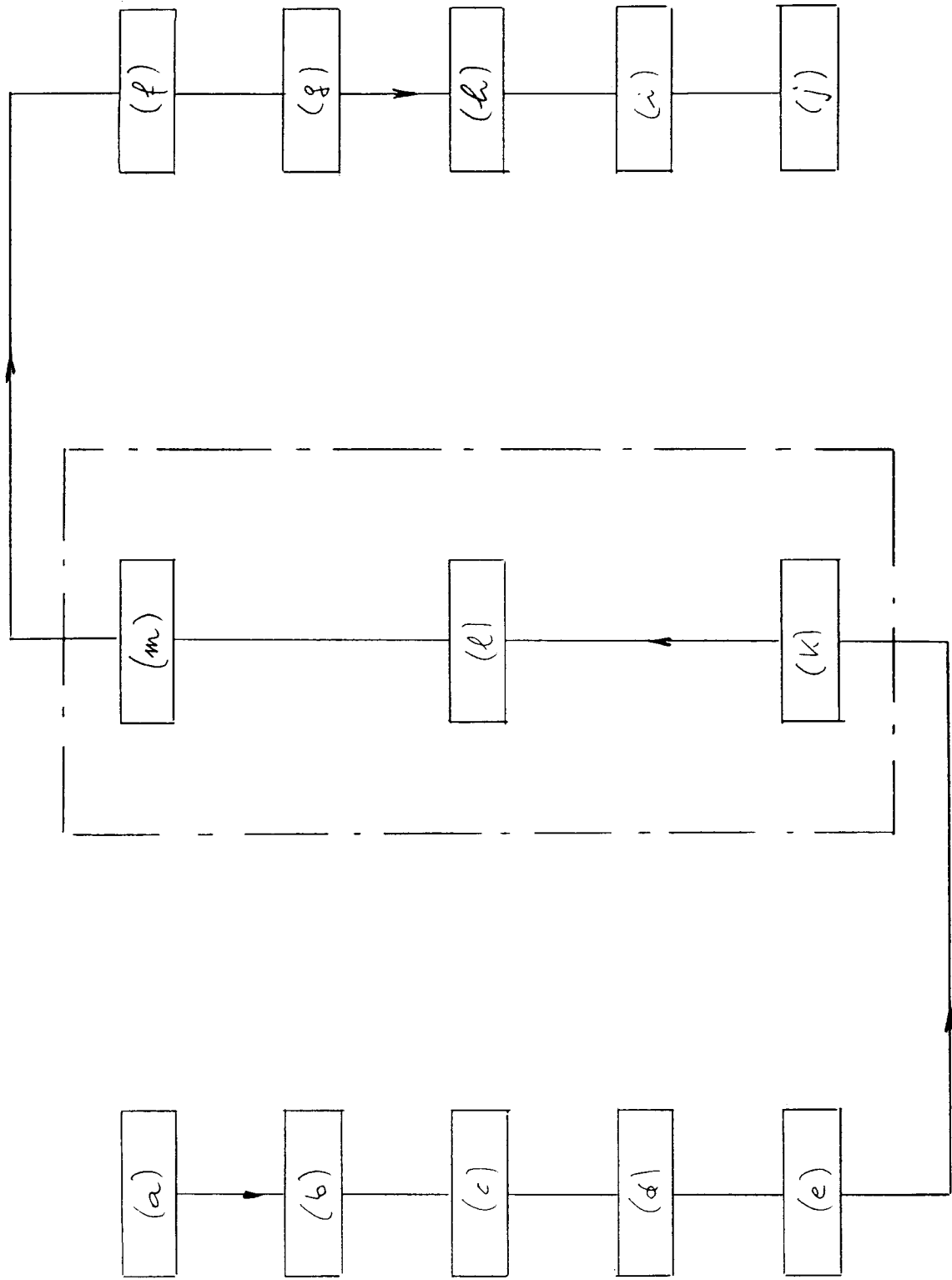


FIG. 1

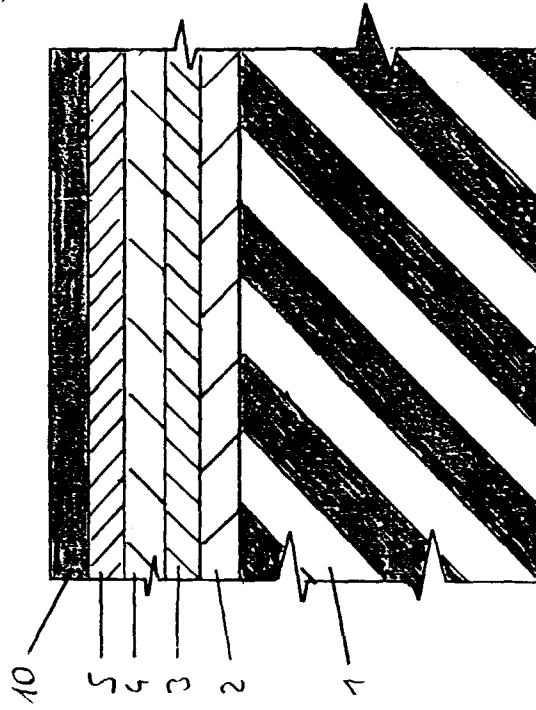


FIG. 3

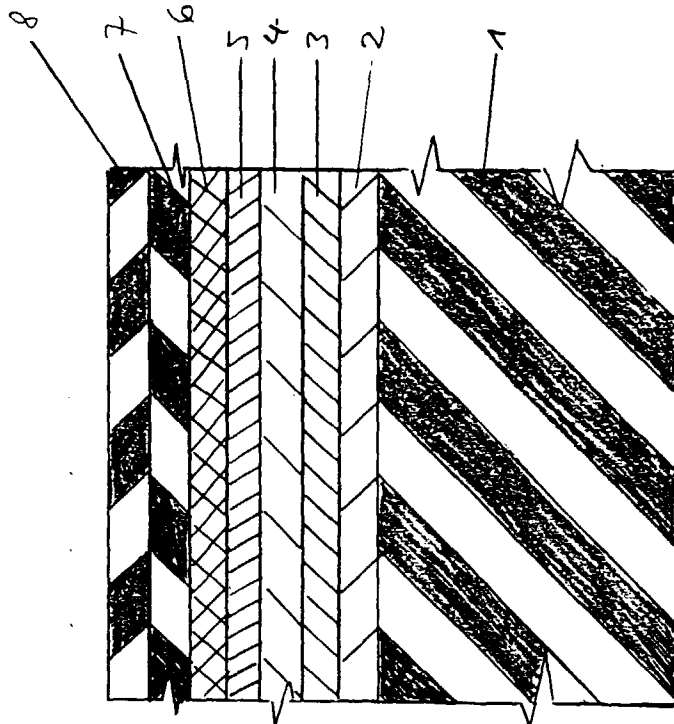


FIG. 2.