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METHOD OF APPLYING PROTECTIVE
LAYERS TO REFLECTING METAL
SURFACES

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This invention relates to methods of applying protective layers to reflecting metal surfaces and to mirrors manufactured with the use of said methods.

It is known to provide a reflecting metal surface on a layer of lacquer provided on a rigid support, thus dispensing with treatments otherwise necessary to smooth the surface of the rigid support. Such reflecting metal surfaces are frequently several thousandths of a mm. thick and consist, for example, of aluminium which, due to its considerable reflecting power throughout the band of visible light is particularly suitable. Alternatively, however, other metals, e. g., silver, may be used. A suitable method of providing the reflecting metal layer consists in vaporizing metal in a vacuum.

In conjunction with the requirements with respect to smoothness, hardness and thermal stability imposed on the support preferably a lacquer capable of being hardened by heating (muffling lacquer) is employed. Due to the heating operation necessary for hardening the lacquer thoroughly, residues of solvents and moisture are vapourized from the layer of lacquer in order that they may not later occasion damage to the reflecting metal surface provided thereon. As is known muffling lacquers best satisfy the requirements imposed.

It has, however, been found that such reflecting metal surfaces do not fulfil stringent requirements imposed with respect to durability, since they are relatively readily damaged by atmosphere influences, dust and handling. It has been suggested to enhance the durability of such reflecting metal surfaces by subjecting them to chemical treatment or by precipitation of quartz vapour on to the metal surface. For reflecting aluminium surfaces a known method is to form a protective layer by oxidizing the surface of the aluminium by electrical agency. When employing silver a protective layer may be formed by heating the mirror in an oxygen or hydrogen peroxide atmosphere.

However, these methods of applying a protective layer are expensive.

The invention consists of a method of applying a protective layer to a reflecting metal surface, provided, for example, by vapourization of metal in a vacuum, on a hardened thermo-setting layer of lacquer, and is characterized in that the reflecting metal surface is covered with a layer of a thermo-setting lacquer which is subsequently hardened at a temperature lower than that at which the layer of lacquer which serves as a

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base for the metal mirror was hardened. The expression "lower temperature" is to be understood to mean a temperature which is at least 15° C. and preferably at least 25° C., lower than the temperature at which the supporting layer of lacquer was hardened.

The protecting layer of lacquer is thin and in order to ensure the desired adherence and durability, a muffling lacquer is chosen for this purpose.

It was found that the reflecting surface was liable to damage during the operation of hardening the protective layer unless said lower temperature was used; presumably due to deformation of the supporting layer of lacquer, bubbles and fissures were formed in the metal layer, thus rendering the reflecting surface unserviceable. However, with limitation to said lower temperature, this is prevented. If, for example, the layer of lacquer required to form the support for the mirror is hardened at 145 to 150° C. for one hour, usually the reflecting surface remains undamaged when muffling the protective layer of lacquer at 125 to 130° C. It is to be preferred to choose the temperature still lower, for example 115° C. In this event, however, the times during which the article furnished with the reflecting surface is subjected to the hardening temperature, are longer. Thus, for example, one and a half hours would be required to harden the lacquer at 125° C. At 115° C. the time of hardening is still longer, for example, two hours.

To provide the protective layer of lacquer use may be made of a spraying method according to which an appropriate lacquer solution is sprayed on to the reflecting metal surface by means of a spray-gun. Preferably, however, the method is employed according to which a small quantity of lacquer solution is applied on to the reflecting metal surface which is subsequently rotated rapidly. This method permits a very thin layer of lacquer to be applied by which the whole surface of the metal mirror is covered. For use in this method and also for obtaining a very thin layer, the lacquer solution should not be too viscous. Preferably, a lacquer solution having a viscosity of 9 to 9.5 degrees Engler at 20° C. is used.

As a thermo-setting protective lacquer, use is preferably made of the same lacquer that has been employed for providing the supporting layer. A very suitable solution consists, for example, of a mixture of an ureaformaldehyde condensation product and a non-drying alkyd resin in xylol-butanol. After muffling, a very hard, smooth and

substantially colourless protective layer of lacquer is provided which firmly adheres to the metal mirror and which is substantially not discoloured by exposure to the atmosphere.

Example

A layer of aluminium several thousandths of a millimeter thick is applied, by vaporisation in a vacuum, to a layer of hardened lacquer, muffled at 150° C., consisting of a hardened mixture of an ureaformaldehyde condensation product and a non-drying alkyd resin provided on a plate of dimensions 80 mms. by 65 mms. curved into part of a spherical surface.

The mirror is subsequently fitted to the turntable of a centrifuge, on to which is applied 1 cc. of a solution of an ureaformaldehyde condensation product and non-drying alkyd resin in a xylol-butanol mixture having a viscosity of 9 to 9.5 degrees Engler at 20° C. On rotating the mirror rapidly the lacquer solution spreads over the metal mirror and dries to form a thin layer. This is followed by after-drying at 60° C. for 20 minutes and muffing at 115° C. for more than 1½ hours. In this manner, a hard, substantially colourless well-adhering layer of lacquer having a smooth surface is formed on the metal mirror. The decrease in the reflecting power of the mirror is at most reduced only by a few percent by said layer of lacquer.

What I claim is:

1. A method of applying a protective layer to a reflecting metal surface comprising the steps of forming a base for said metal surface by providing a first non-opaque thermo-setting layer of lacquer including a non-drying alkyd resin, applying a thin layer of highly reflective metal to said first layer of hardened lacquer, and covering said metal with a second layer of non-opaque thermo-setting lacquer including a non-drying alkyd resin which is subsequently hardened at a temperature that is at least 15° C. lower than that at which said first layer of lacquer was hardened.

2. A method as claimed in claim 1 wherein the composition of said first layer of lacquer is the same as said second layer of lacquer.

3. A method as claimed in claim 1 wherein said first and second layers of lacquer are distributed over said metal surface by the rapid rotation of said metal surface.

4. A method of applying a protective layer to a metal surface comprising the steps of forming a base for said metal surface by providing a first thermo-setting layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin, applying a thin layer of aluminum to said first layer and covering said layer of aluminum with a second layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin which is subsequently hardened at a temperature lower than that at which said first layer of lacquer was hardened.

5. A method of applying a protective layer to a metal surface comprising the steps of forming a base for said metal surface by providing a first thermo-setting layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin, applying a thin layer of aluminum to said first layer and covering said layer of aluminum with a second layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin having a viscosity of approximately 9 degrees Engler at 20° C., said second layer of lacquer being hardened at a temperature lower than that at which said first layer of lacquer was hardened.

6. A method of applying a protective layer to a metal surface comprising the steps of forming a base for said metal surface by providing a first thermo-setting layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin, applying a thin layer of aluminum to said first layer by vaporization in a vacuum and covering said layer of aluminum with a second layer of lacquer comprising an ureaformaldehyde condensation product and a non-drying alkyd resin which is subsequently hardened at a temperature which is at least 15° C. lower than the temperature at which said first layer of lacquer was hardened.

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