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CONDITIONING OF METAL SURFACES

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This invention relates to the conditioning of metal surfaces and, more particularly, to improved processes of treating the surfaces of certain metals in order to both clean and roughen them.

Many processes utilizing sheet metals require the application of coating materials to the metal surfaces. Before the coating materials can be applied, the metal surfaces may have to be, first, carefully cleaned and then roughened somewhat so that the coating will adhere well. In a commonly used process of photoengraving or etching, for example, a coating of a light-sensitive emulsion is applied to the surface of a metal plate. To achieve successful application of the emulsion, it is necessary to clean the metal surface and abrade it slightly, producing a particular type of smooth, velvety, mat finish.

In the past, the surfaces of metal plates have been conditioned for photoengraving by cleaning with a solution of a material such as trisodium phosphate, and roughening by rubbing the surface with pumice powder. This produced a dull surface having a large number of hair-line scratches per inch. Although this method has proved successful and has become widely used, the process obviously necessitates use of two distinct steps of cleaning and abrading, with the latter being a somewhat time-consuming mechanical operation, even when done with a rotating polishing wheel.

The present invention is a method of cleaning and roughening a metal surface in a single-step chemical operation in order to obtain a mat finish. The process comprises treating the metal surface, which is assumed to have been freed of any grease or oil, with a solution of ammonium persulfate containing a small percentage of hydrogen peroxide. This solution has proven effective with metals such as copper, zinc, brass, cadmium, tin, alloys of copper and tin, and alloys of copper and nickel. It may also be applied to aluminum or magnesium or alloys of the two, if these metals are first treated with a solution of hydrofluoric acid.

One object of the present invention is to provide an improved process of conditioning metal surfaces to receive certain coating materials.

Another object of the invention is to provide an improved process of cleaning and roughening the surfaces of various metals in a single operation.

Another object of the invention is to provide an improved method of chemically abrading metal surfaces.

Another object of the invention is to provide

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an improved process of preparing metal surfaces for photoengraving or etching.

Another object of the invention is to provide a chemical method of obtaining a mat finish on various metals.

Still another object of the present invention is to provide an improvement in the process of forming a metal screen by the etching method.

These and other objects will be more apparent and the invention will be more readily understood from the following detail description:

Example 1

A polished brass plate which is to have a design applied to one of its surfaces by a process of photoengraving is first freed of any adhering oil or grease in conventional manner. This may be done by subjecting the sheet to repeated immersions in a tank containing any one or more of various organic solvents such as toluol, carbon tetrachloride, etc. The solvent is removed from the plate by evaporation and the sheet is then immersed in a solution consisting essentially of water, ammonium persulfate $[(\text{NH}_4)_2\text{S}_2\text{O}_8]$, and hydrogen peroxide. The solution comprises the proportions of about 1 liter of water, 250 grams ammonium persulfate and 3 milliliters H_2O_2 . The hydrogen peroxide may be added as 1% by volume of the usual 30% aqueous solution of H_2O_2 . The brass sheet is permitted to remain in this solution for about 1 to 2 minutes at room temperature. It is then removed and rinsed with water to remove all residual traces of the treating solution ingredients. The plate is then dried, preferably as rapidly as possible to avoid staining. The surfaces of the brass sheet will be found to have been given a fine mat finish especially suitable to receive a light-sensitive gelatine emulsion of conventional type. By mat finish is meant one which is even and velvety but dull or lacking in luster. When the treated plate is examined microscopically, the mat appearance is found to be due to the formation of a multitude of tiny projecting crystals.

The presence of the hydrogen peroxide in the treating solution is essential to obtain the desired roughening action on the metal surface. The range of peroxide content may be from about .3% to 1.5% by volume. A solution of ammonium persulfate alone will clean but not abrade. Also, a solution of hydrogen peroxide, alone, will produce no roughening action on the metal. Both ingredients are necessary in combination to produce the abrading action and cleaning is accomplished at the same time. The manner in which

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the persulfate and the peroxide cooperate to produce the abrading action is not understood. Moreover, not all strong oxidizing agents are suitable to combine with the persulfate in this process since most of them attack the metal producing undesirable reaction products.

The process of which the above example is a typical preferred embodiment may be applied in the same manner to sheets of other metals such as copper, alloys of copper and nickel, such as that containing 70% copper and 30% nickel, cadmium, and tin, also any of the copper-tin alloys.

The time of treatment may be varied from about 1 minute to about 30 minutes. The temperature may also be higher than room temperature and is not critical. With higher temperatures, however, shorter treating times are required and the process is somewhat more difficult to control. The H_2O_2 also decomposes more rapidly at higher temperatures. Room temperature is therefore preferred.

The concentration of ammonium persulfate can also be varied from about 10% to about 40% by weight, that is, from about 100 to 400 grams of ammonium persulfate per liter of water. Within this percentage range, the treating time may be varied within the time stated above, provided the solutions are at room temperature.

Instead of immersing the plate in the treating solution, the solution may be flowed over the plate or an even film applied by spraying.

Example 2

A sheet of aluminum which is to have one of its surfaces photoengraved is treated with a one percent solution of hydrofluoric acid for about one-half minute. The residual acid is rinsed off in water and the freshly exposed surface of the aluminum sheet is then treated as described in Example 1. By this process, the aluminum sheet is given a mat finish suitable to receive a coating of bichromated gelatin. Other metals which can be treated by this process are magnesium and any one of the many alloys of magnesium and aluminum. The purpose of the additional pre-treatment with hydrofluoric acid is to remove the thin oxide layer which always forms on unprotected aluminum surfaces. Any conventional method of removing the oxide, other than use of hydrofluoric acid, may be used in this step.

Use of the solutions and the methods of the present invention produce surfaces on metals which are especially adapted to be processed into screens having a large number of holes per square inch. In order to make screens suitable for optical equipment, the holes must be uniform in size and regular in outline. A conventional method

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of making screens of this type is to coat a copper or brass plate with bichromated gelatin, expose the coated plate through a pattern of dots corresponding to the openings desired in the screen, wash off the parts of the coating not exposed to light (the dots) and etch the metal thus exposed, entirely through to the other surface. To make a screen of good optical quality by this method, it is necessary that the hardened portions of the gelatin sharply define limits of the holes and that the coating of gelatin adhere so well that none of the etching solution can flow beneath it, making ragged edges.

I claim as my invention:

1. In a method of imparting a mat finish to a polished surface of a metal of the class consisting of copper and brass, the steps of treating said surface with a solution consisting essentially of water, about 10-40% by weight of ammonium persulfate, and about 0.3 to about 1.5% by volume of hydrogen peroxide, and continuing said treatment until said mat finish has been formed.

2. A method according to claim 1 in which the ammonium persulfate is present in the amount of about 25% by weight and the hydrogen peroxide is present in the amount of about 0.3% by volume.

3. A method according to claim 1 in which said metal is brass.

4. A method according to claim 1 in which said metal is copper.

5. In a method of imparting a mat finish to a surface of a metal from the class consisting of aluminum, magnesium, and alloys consisting essentially of aluminum and magnesium, the steps of removing the oxide film from said surface and then treating the freshly exposed surface of the metal with a solution consisting essentially of water, about 10 to about 40% by weight ammonium persulfate, and about 0.3 to 1.5% by volume of hydrogen peroxide.

6. In a method of imparting a mat finish to a polished surface of a metal of the class consisting of aluminum, magnesium and alloys of aluminum and magnesium, the steps of treating said surface with a solution consisting essentially of water, about 10-40% by weight of ammonium persulfate, and about 0.3 to about 1.5% by volume of hydrogen peroxide, and continuing said treatment until said mat finish has been formed.

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