

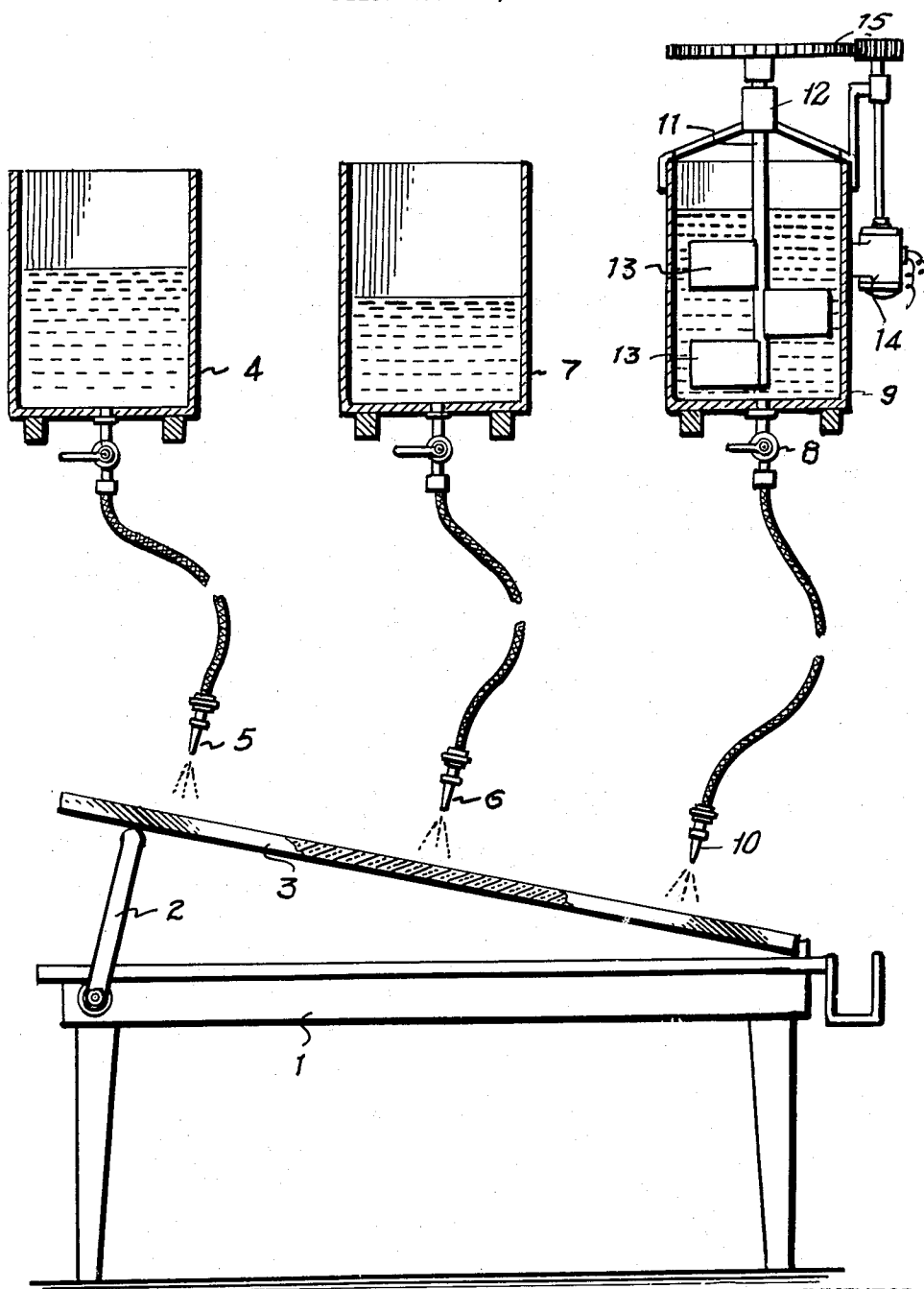
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METHOD AND APPARATUS FOR DEPOSITING COPPER

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METHOD AND APPARATUS FOR DEPOSITING COPPER

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4 Claims. (Cl. 117—35)

This invention relates to an improved method of applying a coating of copper to a surface, as for instance, a protective coating of copper to the silvered reflective surface of a mirror. This application is an improvement of my Patent #2,664,363, issued December 29, 1953.

In the said patent I reveal a simple and economical method of depositing a durable copper coating without the use of an outside source of electric current, the method resulting in a better, more uniform final product manufactured at substantially lower cost and with greatly reduced percentage of rejects.

The method therein revealed entails, first, the application of a coating of silver to a sheet of glass by any known process which leaves little or no scum on the silver, preferably by spraying a silver depositing solution on sheets of glass held in racks so that the next step of depositing copper thereon can be done with no appreciable time intervening which would give the silver coating opportunity to oxidize. The step of depositing the copper is performed by first providing a tank above the work and filling it with a water solution of copper sulphate (CuSO_4), the tank having a hose or feeding outlet for spraying onto the silvered surface. A second tank is also provided above the work containing a very finely divided metallic zinc or zinc dust suspended in water. As a necessary requirement of the invention the suspension of zinc dust in the water must be maintained by continuous vigorous agitation to the point where a homogeneous mixture is obtained. The copper sulphate solution and the solution of water and zinc dust are merged and flowed or sprayed over the silvered surface together immediately after water rinsing the deposition of the silvered surface and while it is still wet. The zinc combines with the copper sulphate releasing free metallic copper which deposits on the silver instantaneously while the zinc flows away and is not found in the silvered surface after water rinsing.

The patent also states that "the method is not necessarily limited to the use of zinc dust and finely divided iron has been found satisfactory as well as certain other commercially available metals above copper in the Activity Series. However, it has been found in actual practice that the use of zinc dust has produced the most efficient results." The object of this invention is to teach the results obtained by the use of metals other than zinc, so that my entire invention which may be described as copper plating by galvanic action may be more fully understood.

Another object of this invention is to teach the proper manner of agitating the powdered dust to obtain a homogeneous mixture with water, since this is essential to good results, as is repeatedly stated.

As is explained in my said patent, it is highly important that the copper coating be actually applied to the silvered surface with the least possible loss of time to avoid oxidation of the silver. Tests showed that when zinc dust was used in the manner described, the reaction causing deposition of copper appeared to be instantaneous. All other metals which I used in substitution of zinc appeared to involve a very slight delay, the delay varying somewhat

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from metal to metal. Another way of explaining this is that when the residue of the solutions which flowed over the silvered surface was tested, it was found that the amount of copper sulphate in the residue varied according to the metal which was used for the reduction and that when zinc was used the amount of copper sulphate was minimum. Thus, since zinc appeared to be the metal which best caused instantaneous and substantially complete reaction and since zinc dust may be purchased commercially at much lower prices than other metallic dusts, I stated a preference for the use of zinc dust.

Other metals which proved acceptable, however, were iron, cadmium, nickel and cobalt, and the chromium group including chromium, tungsten and molybdenum. Those metals all caused precipitation of the copper according to time elements or to a degree of precipitation which varied slightly from each other with iron being most efficient next to zinc, and cadmium being found next most efficient to iron, and nickel and cobalt being indistinguishable from each other in the degree of precipitation. The others enumerated appeared to be less efficient and more expensive. Iron and cadmium appeared to be preferable by a substantial margin. All metals were not tested due to the great difficulty of obtaining many of them in powdered form so that I do not know whether their adaptability to my process follows the Electromotive Series as found in a chemical handbook. Most of the metals are not commercially available in powdered form and most of those which are available are much more expensive than zinc, iron and cadmium.

It is to be understood also that the metals above enumerated, in order to cause satisfactory formation of a copper coating must meet the following requirements: first, they must be used in the form of a dust which is ordinarily defined as being composed of particles which will pass through a screen having approximately three hundred openings per square inch, commonly referred to as -300 mesh material because coarser particles may damage or destroy the silver coating when sprayed under pressure and because substantially coarser particles can not so easily be caused to form a homogeneous solution; secondly, they must be immersed in water and the water must be agitated to the extent that the dust particles will be maintained in homogeneous suspension in the water at the time the solution is released onto the silvered surface; and thirdly, the mixture should be fed in a stream which merges with a stream of copper sulphate solution at or immediately prior to contact of both streams with the silvered surface. As stated in the patent, the silvered surface should be mounted on racks either vertical or flat or at any angle for free flowing of the silvering solution therefrom with care to avoid a scum and for subsequent free flowing of the copper sulphate solution and dust solution therefrom as it is detrimental to the silver if the copper sulphate does not flow rapidly thereover simultaneously with the metallic dust. No dust should come to rest on the silvered surface.

In solving the problem of obtaining a homogeneous mixture of the metallic dust in the water, I have found that it is easily possible to obtain both too much and too little agitation. When the solution is not entirely homogeneous, fair results may be obtained, but there will be some spoilage, some rejects and a percentage of generally imperfect final product, whereas if the solution is homogeneous I have proven that there need not be a single reject over a period of many months of operation.

In order to obtain these superior results I have found that the agitation may best be made by mechanical means as is illustrated in the accompanying drawing in which the figure is a diagrammatic illustration of a silvered sheet of glass in position to receive copper coating according to my improved method and apparatus.

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In the figure, 1 indicates a table having a rack 2 to support a sheet of glass 3 which has been silvered. Thereabove, I provide a source of water supply 4 having a nozzle outlet 5 for rinsing the silvering solution from the silvered surface promptly after deposition thereof. While the surface is still wet with rinse water 1, then, flow the copper sulphate solution thereon by opening a flow through the nozzle 6 from the tank 7. Simultaneously, I also flow the water having the powdered metal suspended in water thereon by opening a valve 8 leading from the tank 9 to the nozzle 10.

In order to maintain the powdered metal in homogeneous solution in the tank 9, I prefer that the tank 9 be of cylindrical shape. Longitudinally of the tank I place a shaft 11 suspended therein by means of a thrust bearing 12 in such manner that the bottom of the shaft will be close to the bottom of the tank, as for instance, $\frac{1}{4}$ inch. Along the shaft from top to bottom I provide several paddles 13, three being sufficient. The shaft 11 should be rotated at a speed of 16 to 20 revolutions per minute and in order to accomplish this I provide a motor 14 having suitable reduction gearing 15 connecting it to the shaft 11. The speed of 16-20 revolutions per minute is not critical since more or less may perhaps be used, but I have found this range of speeds to give excellent results.

After application of the copper sulphate solution and the metallic dust by which the silvered surface has become copper plated the surface is then water rinsed and allowed to dry.

In tests I have found that a solution composed of 16 ounces of copper sulphate per gallon of water and a suspension of metallic dust of any of the six metals above mentioned of 2 or 3 ounces per gallon of water is to be preferred. However, these proportions are not critical since it is possible to vary the strength of the solution in proportion to 6 to 40 ounces of copper sulphate per gallon of water and to vary the density of the suspension of metallic dust in the range of 1 to 6 ounces per gallon of water.

Various slight alterations in the manner of executing my invention may be made without departing from the spirit thereof, as for instance the dust may be a combination of several of the metals with or without zinc, and I therefore desire to be extended protection as defined by the scope of the appended claims.

What I claim is:

1. The method of producing a copper plated silvered mirror including the steps of mounting a transparent plate on a supporting rack, chemically depositing a silver reflective coating from a silver depositing solution on said plate while in its mounted position, and then while the silver reflecting surface is still wet with rinse water and the plate in place on the rack, simultaneously intermingling and spraying onto said surface a copper sulphate solution and a substantially homogeneous fluid suspension of finely divided metal dust to thereby deposit a copper

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protective layer, said metal dust having a fineness of the order of -300 mesh and being selected from the group of metals consisting of iron, cadmium, nickel, cobalt and the chromium group including chromium, tungsten and molybdenum.

2. The method of producing a copper plated silvered mirror including the steps of mounting a transparent plate on a supporting rack, chemically depositing a silver reflective coating from a silver depositing solution on said plate while in its mounted position, and then while the silver reflecting surface is still wet with rinse water and the plate in place on the rack, simultaneously intermingling and spraying onto said surface a copper sulphate solution and a substantially homogeneous fluid suspension of finely divided cadmium dust to thereby deposit a copper protective layer, said dust having a fineness such that substantially all of it will pass through a screen having 300 openings per square inch.

3. The method of producing a copper plated silvered mirror including the steps of mounting a transparent plate on a supporting rack, chemically depositing a silver reflective coating from a silver depositing solution on said plate while in its mounted position, and then while the silver reflecting surface is still wet with rinse water and the plate in place on the rack, simultaneously intermingling and spraying onto said surface a copper sulphate solution and a substantially homogeneous fluid suspension of finely divided iron dust, said dust having a fineness such that substantially all of it will pass through a screen having 300 openings per square inch.

4. The method of producing an article having a copper plated silvered surface including the steps of mounting the silver surfaced article on a support, simultaneously intermingling and applying to said surface a stream of copper sulphate solution with a fluid stream composed of a mixture of water and finely divided metal dust having a fineness of the order of -300 mesh taken from the group of metals consisting of iron, cadmium, nickel, cobalt, and the chromium group including chromium, tungsten and molybdenum, while on said support, said water and metal dust being maintained in substantially homogeneous suspension by the continuous and vigorous agitation of the supply of said mixture.

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