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METHOD AND APPARATUS FOR APPLYING EXPENDABLE PROTECTIVE COATINGS ON FINISHED SURFACES

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This invention relates to the art of protective coatings in general and in particular has reference to a method and apparatus for applying a temporary protective coating on a finished surface for the purpose of providing protection for the same during periods of shipment and/or installation.

It has long been known in the prior art that finished surfaces can be protected by the use of protective coatings of various types. However, in the past, the utility of such coatings has been limited by the difficulties in respectively applying and removing the same preceding and/or following use thereof for protective purposes.

It has been discovered that an improved expendable type of temporary protective coating can be provided by providing water soluble protective coatings on the finished surface of an article so that the same, following installation, can be removed by merely spraying or otherwise exposing the same to water that will serve to dissolve the coating with a minimum amount of effort.

It has been further found that such a water soluble coating of this type can be formulated to minimize the problem of applying the same to the surface in question by preferably formulating the same so as to include, as a major constituent of the applied composition, a volatile solvent that will rapidly dissipate or dissolve following application of the coating so as to leave a residual protective coating that is water soluble while yet having protective coating characteristics.

In this regard, it has been found that if polyethylene glycols within the certain molecular weight ranges, are formulated into volatile solutions of various forms, there will be provided a protective coating that will serve as an expendable shield or coating for a finished surface with the water solubility of the coating permitting removal as desired upon exposure to water.

More specifically, it has been found that polyethylene glycols having molecular weights of between 1,000 and 20,000 can be advantageously mixed with certain solvents selected from the group consisting of water, alcohols and aromatic hydrocarbons, so as to provide a coating solution that is capable of being readily applied in various ways over a finished surface, with the concentration of wax in the protective solution being variable from 4 to 40 percent by weight dependent upon the particular method of application employed.

Thus, for example, in cases where the solution is applied to the surface in atomized condition, such as in air spraying, it has been found that the wax solution will preferably vary from between 4 percent by weight to about 20 percent by weight. Additionally, in instances wherein increased viscosity is desired, such as in applications by roller coating or dipping processes, the wax concentration preferably will be elevated to between 20 and 40 percent by weight.

It has also been found that in the instance of use of the aromatic hydrocarbons, as the carrying medium for the wax, it will be preferable to employ certain techniques that will serve to stabilize the solution so as to make the application thereof more feasible from a production standpoint.

Specifically and with regard to the use of aromatic hydrocarbons such as toluene and xylene, it has been discovered that unless the solution containing the same is

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maintained at an elevated temperature of at least 50 degrees centigrade, that the wax which has dissolved in these solvents will coagulate or jell on cooling so as to make application of the solution impractical.

To eliminate the necessity of maintaining such an elevated temperature under production conditions, it has been found that if methanol is added to the solution of wax and either toluene or xylene, that then and in that event, the temperature at which jelling or coagulation will occur will be materially lowered, with the result that the need for elevated temperatures can, for all practical purposes, be obviated by the addition of methanol to the solution containing the aromatic hydrocarbons.

Hereinafter is set forth representative examples illustrating the above principles.

TEST SERIES A*(a) Purposes of test 1 through 6D*

Panels 1 through 6 made in Test Series A are intended to show the acceptable range of polyethylene glycols that can be utilized in connection with any of the selected solvents. For ease of application, Examples 1 through 6 are illustrated as using the aromatic hydrocarbons for the solvent because of the relatively rapid rate of volatilization or evaporation that occurs with such aromatic hydrocarbons. Tests 6A through 6D show alternative methods of application in the absence of heat in the panel.

To avoid the use of elevated temperatures in testing procedure, methanol has been added to stabilize the coating as above indicated.

(b) Preparation of coating compositions employed

For the purpose of Test Series A, five different coating compositions were prepared and were respectively labeled coating compositions A, B, C, D, and E.

Coating composition A was prepared by admixing 10 parts of Carbowax #1,000 with 85 parts of toluene, with the resulting admixture being heated to above 50 degrees centigrade. Following heating as above described, the mixture was allowed to cool whereupon 5 parts of methanol was added for stability purposes previously discussed.

The composition so obtained was found to be stable for application purposes at room temperature.

Coating compositions B, C, D, and E were prepared in identically the same fashion except that Carbowax #1540, Carbowax #4000, Carbowax #6000 and Carbowax #20,000 were respectively utilized as the wax ingredients of compositions B, C, D and E.

(c) Testing procedure

Five aluminum panels prefinished by having enamel baked on one surface thereof and all having been preheated to approximately 250 degrees F. were respectively sprayed in equal amounts while in their preheated state with coating solutions A, B, C, D, and E above described, and in each case, a portion of the painted surface was masked off during the application of the respective coating compositions. The panels so produced were then allowed to cool for approximately two minutes whereupon it was observed that a wax protective coating formed over the finished surface that had been sprayed.

Following such drying and cooling, the edge of a twenty-five cent coin was vigorously rubbed over the coated surface and was also rubbed over the unprotected surface that had been masked off during the application of coating.

Following this, there was a further masking off of a coated portion of each panel, whereupon water was applied to the unmasked part of each panel whereupon the protective coating in the unmasked region was readily removed. The panels were then marked Exhibits 1, 2, 3, 4 and 5 respectively.

(d) *Physical properties of Exhibits 1 through 5*

Panel 1 possessed minimal protective quality and marking in the coated area was observed. In panels 2 and 3, there were mere traces of marking in the protected area. No marking at all was observed in panels 4 and 5 which indicated that complete protective coating had been applied. In subsequent tests, a greater amount of coating compositions A, B and C were sprayed on the panels in the fashion described in connection with Exhibits 1, 2 and 3, and in such instance, the amount of coating thickness was approximately doubled, and it was found that protective qualities were obtained.

However, in order to obtain protective quantities using composition A, it was necessary to apply approximately four times as thick a coating as was necessary in the case of tests 4 and 5. Composition coatings obtained in tests 1, 2 and 3 were somewhat oily to the touch while the coatings of panels 4 and 5 progressively increased respectively in hardness.

The coating compositions were readily removable upon the application of water thereto although it was observed that the ease with which the coating was dissolved by water decreased as the molecular weight of the polyethylene glycol increased.

(e) *Conclusions*

Polyethylene glycols having molecular weights of between 1,000 and 20,000 may be satisfactorily employed in water soluble coating compositions of the type herein described. The hardness of the coating obtained will increase in proportion to the molecular weight of the polyethylene glycol with minimal hardness of coating being present with minimal molecular weight while maximum hardness is obtained with the highest molecular weight.

Additionally, while all coatings are readily soluble with the influence of water, the ease of removal becomes somewhat greater as the molecular weight decreases.

(f) *Example 6*

The test procedure employed with respect to Example 4, above recited was repeated with the exception that xylene was substituted for toluene in the same exact percentage ratio to produce composition F. The panel resulting was marked Exhibit 6 and was compared against panel 4. It was observed that panel 6 had a slightly higher gloss than did panel 4 and it was theorized that this resulted from the fact that the xylene had a lower rate of volatilization. The only additional distinction observed was that panel 6 took a slightly longer time to completely dry.

(g) *Examples 6A through 6D*

Examples 6A through 6D are intended to illustrate the ability of the above coating compositions to be applied to a cold panel with certain of the tests utilizing application methods other than spraying. Accordingly, in test 6A coating composition D (Carbowax #6000) was sprayed on a cold panel with the same number of passes as had been the case in Example 6. While the panel of test 6 dried immediately, approximately fifteen seconds drying time was required in the case of panel 6A. The coating surface provided thereon corresponded materially in all respects to that of panel 6.

In test 6B, a cold panel was dipped in test solution B and was found to be dried in approximately one minute. The coating, however, was found to be too thick and capable of being flaked off.

In subsequent tests, the concentration of composition B was lowered to 4 percent instead of 10 percent and panels dipped in this modified composition D produced a coating equivalent to that of test panel 6.

In panel 6C, a cold panel was dipped in composition F which has the toluene as the solvent. The drying time was observed to be thirty seconds and further the coating did not have the thickness that was present in test panel

6B. This was believed to illustrate the lower viscosity that is created by the presence of toluene which has a solvency power higher than the xylene.

Test panel 6D was produced by spraying a cold panel with composition F. The results were in all respects equivalent to those of Example 6 above.

The conclusions reached from the tests 6A through 6D was that an appropriate coating can be obtained without the use of heat provided that conditions exist to permit drying time of one minute or less. These tests also prove that the composition can be applied in different fashions, but that in the instance of such applications, the concentration may have to be decreased to achieve a coating that is satisfactory from a production standpoint.

TEST SERIES B

(a) *Purpose of tests 7 through 12*

Test Series B was conducted for the purpose of determining the result that would be obtained with the use of methanol as the carrying solvent for the wax and specifically was intended to show the desirable advantages of using methanol as the solvent carrier for the wax in the upper ranges of wax concentration with the utility of the methanol being proved by virtue of the drying speed that is possessed by the same.

(b) *Preparation of coating composition employed*

Two test solutions marked test solution X and test solution Y, respectively, were prepared as follows:

TEST SOLUTION X		Parts by weight
Methanol	-----	90
Carbowax #6000	-----	10
TEST SOLUTION Y		
Methanol	-----	80
Carbowax #6000	-----	20

(c) *Testing procedure*

Two unheated metal panels having finished surfaces were then dipped in the respective containers containing test solutions X and Y so as to produce test panels that were respectively marked Examples Nos. 7 and 8.

Following this, two additional metal panels marked Examples 9 and 10 and having finished surfaces were heated to 250 degrees F. and then sprayed with test solutions X and Y respectively. Panel 9 was sprayed with twice as many passes as panel 10.

Following the above, two additional panels were sprayed while unheated, with test compositions X and Y and marked panels 11 and 12 respectively. The number of spraying passes were identical in each case.

Further, in the case of dipped test panels 7 and 8, the panels were only partially dipped so as to provide coated and uncoated portions of the finished surface. In panels 9, 10, 11 and 12, a portion of the finished surface was masked off to similarly provide coated and uncoated portions of the unfinished surface.

(d) *Physical properties of Examples 7 through 12*

Panels 7 through 12 all had protective coatings thereon that resisted marking by the edge of a twenty-five cent coin rubbed vigorously across the same. Further, the coatings were all readily soluble with water although it was observed that the coatings made from test solution Y were more difficult to remove than those of test solution X where the respective solutions have been applied in equal amounts.

Further the coating of panel 8 was appreciably thicker than the coating of panel 7. The coating thicknesses of panels 9 and 10 were approximately identical. This was theorized to exist because of the fact that the higher concentration solution (test solution Y) had been applied

with eight passes, while the lower concentration solution (test solution X) had been applied with sixteen passes.

With respect to the coatings of Examples 11 and 12, coating 12 was noted to be appreciably heavier than coating 11.

As to drying times, the following were observed:

Panel 7	1 minute with fan.
Panel 8	1 minute, 30 seconds with fan.
Panel 9	Instant.
Panel 10	Instant.
Panel 11	15 seconds.
Panel 12	15 seconds.

(e) Conclusions

The thickness of the coating deposited on the panels increases in direct proportion to the wax concentration of the coating and further the drying time is also directly proportional to the wax concentration. Further the effort required to remove the wax coating with water also increases slightly as the wax concentration increases, although removal in no instance presented any problem.

Coating of equivalent thickness and protective qualities can be achieved by using different wax concentrations, provided provision is made for varying the amount of coating applied.

TEST SERIES C

(a) Purpose of Test Series C

Test Series C is intended to show the utility of water as the solvent vehicle utilized in proving the inventive concepts herein involved, with various concentrations of wax solutions being applied under different conditions of application and temperature to illustrate the operative range that can be utilized.

(b) Preparation of coating compositions employed

Four coating compositions marked P, Q, R, S, and T were prepared to the following formulation:

COMPOSITION P

	Parts by weight
Carbowax #6000	5
Water	95
Detergent.*	

COMPOSITION Q

Carbowax #6000	10
Water	90
Detergent.*	

COMPOSITION R

Carbowax #6000	20
Water	80
Detergent.*	

COMPOSITION S

Carbowax #6000	30
Water	70
Detergent.*	

COMPOSITION T

Carbowax #6000	40
Water	60
Detergent.*	

* In each case, a few drops of detergent (sodium hepta-decyl sulfate) were employed to provide detergent in the approximate amount of 1½ percent of the solid weight.

(c) Testing procedure

In each of the various tests, subsequently described in detail, aluminum panels having an enamel baked thereon were employed and in each case, only a portion of the finished surface was applied with the protective coating so as to, in effect, provide protected and unprotected finished portions of the finished surface.

As the tests will bring out, in some instances, both the panel and the protective coating composition were applied in a hot form with the solution being heated to approximately 150 degrees F. when applied as a coating

solution, and with the panel being heated to approximately 250 degrees F. when considered hot for the purposes of these tests. The methods of application varied including spraying of various types and roller coating, and by like token, the drying methods utilized were also varied. In some instances, where the words "air dry" are employed, the panel was dried at room temperature without directing any air across the same. Where the word "fan" is used, it indicates that a stream of air was directed across the surface of the panel by an ordinary electric fan. Finally, where the words "hot fan" are used, it indicates that the panel was dried by having a stream of heated air such as would emit from a hair dryer, directed across the surface of the panel.

Additionally, in each test involving the application of the coating composition by spraying, a certain number of "passes" with the spraying gun were involved and in each such instance, this data is recited.

In all instances, the coated panels were subject to rubbing action with the edge of a twenty five cent piece that was moved vigorously across the protected and unprotected portion of the complete panel to test the mar-resistant qualities of the protective surface.

(d) Test using composition P (panels 14, 16, 21, 22, 26 and 28)

Test panel 14 involved the application of test solution P at room temperature onto a panel that had been heated to 250 degrees. Test solution P was applied by 16 passes of the spray gun. The panel was allowed to air dry under normal room conditions and was completely dry at the end of four minutes. The coating produced on panel 14 had excellent physical properties both as to hardness, appearance, gloss and solubility with respect to subsequently applied water solution.

For panel 16, the procedure involved with respect to test panel 14 was repeated with the exception that solution P was applied to test panel 16 while at the elevated temperature of 150 degrees. Again, the coating produced on panel 16 was excellent in all respects with the heating of the panel serving to reduce the drying time to two minutes.

Test panel 21 involved the application of cold solution P onto a cold panel by the medium of spraying with 12 passes. The coating produced on panel 21 dried in approximately 7½ minutes under normal air drying conditions. The film produced did not have sufficient thickness to be completely mar-resistant. A subsequent panel repeating the above testing procedure, but utilizing 16 passes was found to produce a sufficient thickness of coating to be completely protective to the marking tendencies of the edge of the coin, but in such instance, it was noted that the drying time was increased to 8 minutes.

Test panel 22 was produced by applying (16 passes) test solution P at room temperature onto the painted surface of a panel that was also at room temperature. A fan was utilized to dry the surface and it was observed that the surface was completely dry in three minutes and twenty seconds. The protective coating produced was excellent in all respects and compared with the protective coating provided on panels 14 and 15.

Panel 26 repeated the experiments of panel 22 with the exception that the panel was heated to 250 degrees prior to the application of test solution P at room temperature by spraying. The effect of heating the panel produced, reduced the drying time of the panel 26 to one minute and fifteen seconds. Again the protective coating provided was excellent.

Panel 28 repeated the experiments of panel 26 but used hot air drying technique using air that emitted from a hair dryer which air was directed across the face of the panel. The panel was found to be dry in twenty seconds and the coating produced on panel 28 was excellent in all respects.

(e) Tests using composition Q (panels 15, 17, 18, 29, 30, 25, 32 and 33)

Test panel 15 was produced by spraying (8 passes) test solution Q at room temperature on the finished surface of a panel that had been heated to 250 degrees. The panel was air dried without the use of a fan and the drying time was two minutes. The coating solution produced on panel 15, although possessing satisfactory mar-resisting qualities, was not equal in appearance to that produced on test panel 14 for example.

Specifically, there was a pebbled texturing effect that is theorized to have been caused by the low wet film thickness that resulted from the use of half as much water. Accordingly, there was an insufficient cooling effect to produce a smooth flowing effect that was achieved in panel 14, for example.

In panel 17, the procedure of panel 15 was repeated with the exception that test solution Q was applied at an elevated temperature of 150 degrees. The drying time of test panel 17 was reduced to fifty-two seconds and the texture of the coating composition showed a marked improvement over that of panel 15.

In test panel 18, the procedure of panel 15 was repeated with the exception that the pressure in the spray gun was increased and the number of passes was reduced to four. An improved texture in the resulting composition was noticed and this was theorized to exist because of the fine atomization that had been created with respect to the particles employed under greater pressure. Additionally, a reduced drying time of forty seconds under normal conditions was observed.

Panel 29 involved the use of a cold panel in test solution Q applied by spraying (8 passes) at room temperature. The panel was allowed to air dry and the drying time was observed to be 9½ minutes. The protective coating so produced had an excellent gloss and compared favorably to panel 14.

In panel 30, the procedure of test panel 29 was repeated with the exception that the test solution Q was applied at a temperature of 150 degrees F. and further a fan was employed to dry the coating surface. The results of the coating applied on test panel 30 was excellent and was equivalent in all respects to that of panel 29, and the drying time was reduced to two minutes.

In test panel 25, solution Q at room temperature was sprayed (8 passes) onto a cold panel. The heated air from a fan was utilized to dry and a protective coating composition was provided, and the drying time was observed to be reduced to one minute. The finished surface was excellent in all respects.

Test panel 32 repeated the procedure executed with respect to test panel 29 with the exception that a fan was utilized to dry the coating in lieu of the hot fan utilized in test panel 25. The coating composition applied was excellent. The only difference being that the drying time was increased to one minute and ten seconds. The protective coating was in all respects, equivalent to that of test panel 25.

Test panel 33 repeated the experiments that had been conducted with respect to test panel 17 but increased the number of passes to twelve so as to apply a greater thickness of coating composition. The effect observed was that the textured or pebbled effect was removed from the coating composition. The drying time was observed to be fifty seconds which is approximately the same as was the case in test panel 17.

(f) Tests using composition R (panels 19, 23 and 35)

Panel 19 was produced by heating the panel to 250 degrees and applying test solution R while at 150 degrees F. by the use of a roller. The panel was then dried by air without the use of a fan. The resulting coating was textured in localized regions and was excellent in other localized regions, thus indicating that the limitations in finish of the coating were caused principally by the limi-

tation of the facilities at hand. The coating surface dried in two minutes and thirty five seconds and was mar-resistant.

Panel 23 was produced by spraying (4 passes) solution R onto a panel that had been heated at 250 degrees F. The coating, dried in thirty seconds, produced and had excellent mar-resisting qualities although the surface was observed to be somewhat textured with such textured surface being theorized to have occurred because of the lack of flow out due to the high concentration of solids with drying time being observed to be thirty seconds.

Panel 35 was produced by spraying (4 passes) solution R at room temperature onto the finished surface of a panel that was also at room temperature. Heated air was employed to dry the coating and the drying time was observed to be one minute. The coating surface was textured similar to that of panel 23 but had excellent mar-resisting qualities.

(g) Test using composition test solution S (panel 20)

Panel 20 was produced by applying test solution S at room temperature to a panel that had been heated to 250 degrees F., with a roller being used to apply the same. The panel air dried in five minutes.

The coating thus produced was relatively heavy but the mar-resisting qualities of the same were excellent. It was theorized that in production, with the use of sensitive adjustable rollers, that the coating could be made uniform and of proper thickness.

(h) Test using test solution T

Panel 37 was produced by applying test solution T at room temperature to a finished surface of a panel that was also at room temperature.

The coating conformed for all practical purposes to that produced by the use of test solution S (panel 20) although the coating was slightly thicker due to the higher degree of wax concentration. It was again theorized that production equipment could be utilized to produce a proper thickness in the coating composition. The drying time was observed to be eight minutes.

(i) Conclusions

Test Series C proved that water can be used as the volatilizing agent by which the wax coating is applied as a protective film over a finished surface. Test Series C also proved the feasibility of applying such coatings in the low wax concentration range (5 to 20 percent) by the use of spraying, while solutions having higher wax concentration (20 percent or higher) lend themselves to being preferably applied by the use of rollers or dipping.

Test Series C additionally proved that panels what were sprayed cold had a higher gloss than panels that were sprayed hot except in the case of test solution P where the large amount of water served to provide a cooling effect to the panel.

In addition to the aforementioned test series, test panels were also run using a small amount of food coloring in certain of the solutions of Test Series C. The results were no different so as to prove that a colored coating could be provided with no appreciable difference in quality of the coating.

The aforementioned examples comprising Test Series A, B and C profusely illustrate the concept that any number of volatile solvents can be utilized as the carrying medium for certain wax compositions, with the tests illustrating, that upon evaporation of the volatilizable solvent, the wax will be deposited as a protective coating over the finished surface so as to protect the same during packing, transit or installation.

It has been further shown, in each of the tests, that the coating so provided can readily be removed by merely subjecting the same to the influence of water.

Accordingly, while a full and complete description of the invention has been set forth in accordance with the dictates of the patent statutes, it is to be understood that

the invention is not intended to be limited to the specific embodiments above shown for illustration purposes, but is rather intended to be limited by the scope of the appended claims.

What is claimed is:

1. A method of prevention of scratching and marring of the decorated side of a sheet metal article during handling, shipping and erection which comprises the steps of preparing a solution of an admixture of polyethylene glycol and a solvent selected from the group consisting of methanol, toluene and xylene with said polyethylene glycol having a molecular weight of from about 1,000 to not more than about 20,000 and with said glycol being about 4 percent to about 40 percent by weight of said solution; and applying said solution to said sheet metal article; and evaporating the solvent from said solution.

2. The method of claim 1 wherein said solvent is evaporated from said solution by utilizing the residual heat in said metal article resulting from the baking of said decorative coating on said metal article.

3. The method of claim 1 wherein said surface is aluminum.

4. The method of claim 1 wherein said metal surface is in a heated state prior to being coated with said composition whereby residual heat in said metal volatilizes said solvent.

5. The method of claim 1 wherein said coating composition is applied by spraying.

6. The method of claim 1 wherein said coating composition is applied by dipping.

7. The method of claim 1 wherein said coating composition is applied by roller coating.

8. The method of claim 1 wherein said volatilization is accelerated by moving air across said coated metal surface.

9. A sheet metal article at least one side of which is decoratively coated having deposited over said decorative coating as a marproofing and temporary protective agent, a removable coating consisting essentially of a polyethylene glycol having a molecular weight of from about 1,000 to not more than about 20,000; said coating being the evaporation product of a solution that is an admixture of polyethylene glycol and a solvent selected from the group consisting of methanol, toluene and xylene.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

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Ronald P. Steeg

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 9, line 7, for "side" read -- surface --.

Signed and sealed this 21st day of June 1966.

(SEAL)

Attest:

ERNEST W. SWIDER

Attesting Officer

EDWARD J. BRENNER

Commissioner of Patents