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PROTECTIVE COATING

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This invention relates to an easily removable protective coating for various articles and, more particularly, to a hard, scratch-resistant pigmented protective film for liquid application to various metal, glass and plastic articles and the like to provide temporary covering of the surface of the article during processing or treatment and protection from scratching or marring as, for example, during shipping or further handling or fabrication thereof, with the coating being readily removable when desired on completion of the covering and protecting function thereof.

In the manufacture and/or assembling of various structures, machines, or devices, there are many instances where a single, perhaps relatively small, part is produced, or even mass produced, at one location and then shipped to another location for inclusion or fabrication or assembly into the finished construction. In many such instances it may be desired that the particular part receive its final surface finish or treatment (such as a high polish for decorative or functional purposes, a surface layer of paint, or the like) prior to being shipped to its final destination and/or prior to being assembled or fabricated into the finished structure.

In such cases, then, it may be desired to protect the finished surface of the part from being scratched or otherwise marred or disturbed during shipping, handling, assembly, or further fabrication, and that such protection be readily removable whenever desired, even after incorporation of the part into the finished structure, and be such as not to interfere with the further fabricating or assembly steps to be performed. As illustrative of a few examples of such parts to which the protective coatings of this invention are particularly directed, one may note such items as metal trim or decorative pieces for automobiles and buildings, glass window panes and windshields and mirrors, as well as the highly polished exterior panels or sections for airplanes, rockets, missiles, and the like.

As will be understood, of course, if it is attempted to protect the finished surface of such articles or parts by conventional wrapping paper or even by adhesive coverings, some difficulty may be experienced in the handling or shipment of the articles and/or in assembly thereof or removal of the wrapping after assembly, and even attempting to protect the finished surface of such parts by an overlaid or applied coating may also exhibit some difficulties in the removing of the coating if it is not readily soluble, just as adhesive or other paper coatings, particularly on large parts, may make impractical or wasteful the removal thereof after assembly into the finished structure.

According to this invention, however, a hard and scratch-resistant coating is provided for temporary application and protection of a surface to be protected to form thereover a hard corrosion-resistant and scratch-resistant film after liquid application to the surface, which film is in the form of a matrix or discrete particles in a free flowing liquid binder and including a corrosion-protective pigment effective for inhibiting moisture-induced corrosion, which film coating is susceptible to ready removal from the surface to which applied as by washing or steam cleaning when desired and, in addition to being easily applied by a variety of methods as a liquid and

readily dried, also includes, preferably, a component for adding to the flexibility thereof to permit actual flexing or bending or forming or drawing operations on the material to which the coating is applied without disruption of the coating.

With the foregoing in view as principal objects and advantages of this invention, other objects and advantages will be apparent from the following description and the appended claims.

Essentially, the compositions according to this invention satisfactorily embodying a liquid solution of film-forming binder material in which is admixed an inert filler for forming a matrix coating therewith upon drying of the binder and solvent removal therefrom. Additionally, these compositions include a corrosion-resistant pigment or component for resisting moisture-induced or other corrosion of the part being protected. That is, although the primary function of coating compositions embodying this invention is to provide a hard and scratch-resistant temporary coating on the part being treated, the very presence of such coating for such purpose might protect or abet corrosive action should atmospheric moisture permeate the coating—which possibility is quite real in view of the fact that, preferably the dried coatings formed from compositions embodying this invention are sufficiently water soluble to be removed from the coated parts by washing with water. Since coating compositions of this invention are particularly designed and adapted for application to and protection of highly polished metal and glass surfaces, the composition also includes components for adjusting and controlling the surface tension of the liquid composition for assuring the ready formation of a continuous flowed coating film or layer over such inherently hard-to-wet surfaces as highly polished metals, glass, plastic, and the like.

As noted below, in the several illustrative examples set forth, a preferred class of materials for providing the liquid film-forming and binding component of compositions embodying this invention is the alkali metal silicates in water solution, and satisfactory results are obtained with such materials over a wide range of basic oxide to acid silicate ratios from the extreme alkaline to the extreme acid side, with, of course, adequate surface tension and viscosity adjustment as indicated below. Satisfactory results have been obtained with various of the alkali metal silicates and including those of sodium, potassium, and lithium, with the preferred basic-to-acid component ratio range being approximately 1:3.

As will be understood, a water solution of soluble alkali metal silicates may not readily wet highly polished metal, glass, or similar surfaces to form a continuous film thereover, and this characteristic may become most apparent with surfaces such as stainless steel, chromium plating, mirrored surfaces, and the like, which are the very surfaces for which protection is most desired according to this invention, and even when it is attempted to adjust the surface tension of the silicate solution with an appropriate wetting agent or surfactant material. Accordingly, not only a maintained and assured continuity of the dried film but also the other enhanced characteristics of this invention are believed in large part attributable to the formation of a matrix-type protective coating by the inclusion in the composition of a substantial amount of inert and insoluble filler material in powdered or discrete particle form.

Satisfactory selections of an appropriate such inert filler component include diatomaceous earth, barytes, fuller's earth, and the like. It has furthermore been found, according to this invention, that the use of mica, graphite, molybdenum disulphide, and the like as all or a part of the filler component provides in the dried film a matrix

of enhanced resiliency or flexibility so that the part, after having been finished or polished and coated, may be subjected to substantial flexing or bending or even drawing operations during further fabrication and assembly into the final construction without disrupting or crazing or otherwise inhibiting the protective effect of the coating. As will be understood, particularly in the assembling of flat polished sheets of metal into the curved contours of an airplane or rocket exterior, some bending or flexing may well occur; and, particularly with larger coated parts, if such bending or flexing caused disruption of the protective coating, such disruption might well be at the particular moment of handling and assembly where the protective function of the coating against scratching or marring was most needed. It should also be recognized in this connection that the high polish of the exterior of rockets or missiles may be, indeed, a matter of critical operational importance and not merely one of decoration or ornamentation.

As noted, preferred compositions according to this invention are readily removed, when their protective function is completed, by washing with water or steam cleaning and are, accordingly, formed of a substantially water soluble material. It has been found that the preferred water solubility of the dried coating is by no means disadvantageous to its protective function since, among other reasons, the various parts and articles to which this invention relates are routinely subjected to inside storage, handling, and shipment during that period of time prior to final assembly when the protection of the instant coating is desired. Nevertheless, atmospheric moisture (and especially salt-laden atmospheric moisture) may, in some instances, provide a source of possible corrosion of the protected part on prolonged storage. Accordingly, satisfactory results are achieved by incorporating into the compositions embodying this invention a moderate or minor proportion of a high oil absorptive opaque pigment material having a corrosive-resistant function. Although, during its protecting period, the matrix coatings of this invention are dried and maintained at a very low moisture content and although such pigmentation would be similarly dried, the pigment material is uniformly distributed through the dried matrix coating and is selected to exercise a corrosion-resistance at any point therein where corrosion-inducing moisture may penetrate the matrix film, and, particularl, to resist the situation where moisture might penetrate the film at one point and corrode the coated part beneath the film.

As will be understood from the foregoing, a variety of such high oil-absorptive opaque materials having appropriate corrosion-resistant or protective characteristics are satisfactorily utilized in these compositions, with various inorganic metal salts, particularly the chromates and dichromates, being preferred. It should also be noted that such pigment components (as well as all the other components of compositions embodying this invention) are preferably selected, within the foregoing teachings, so that the ultimate composition, when dried to form the desired matrix film on the part to be protected, is substantially colorless or, at least, does not possess a definite or dominant color so that differently colored dyes or other coloring matters may be added to the compositions embodying this invention for the color-coding or identification by different colors of various different coated parts for aid in handling, storing, and identification thereof at the point of assembling into the final construction.

As will be understood, a liquid composition formulated in accordance with the foregoing teachings and components selected in accordance therewith may not always possess desired or satisfactory surface tension characteristics for adequately flowing over or wetting or forming a continuous film or coating on such hard-to-wet highly polished and impervious surfaces as those to which compositions according to this invention are particularly directed. Accordingly, a surfactant component or surface

active agent is also included in these liquid coating compositions to adjust the surface tension thereof for adequate wetting and for forming a continuous liquid layer and a continuous dried matrix film over the surface to be protected.

Although a wide variety of surfactants capable of breaking or lowering the surface tension of the liquid composition sufficiently for adequate wetting produce satisfactory results, the non-ionic type of surfactant, as indicated in the illustrative examples set forth below, is preferred, it being understood, of course, that the selection of a particular surfactant will be made with due regard, as understood in this art, to the requirements of the particular surface to be coated, the surface tension characteristics of the dispersion composition, as well as the final pH thereof, etc.

As illustrative of the compositions satisfactorily embodying the teachings of this invention may be noted the following examples wherein the formulations are given as parts by weight:

Example I

Sodium silicate ($Na_2O:SiO_2=1:2.8$) in water diluted to sp. g. 1.3	15.00 parts.
Zinc chromate	.25 part or 1.4%.
Diatomaceous earth	.200 parts or 11.6%.
Nonyl phenoxy polyoxyethylene ethanol	.12 part.

Example II

Potassium silicate ($K_2O:SiO_2=1:2$) in water diluted to sp. g. 1.4	14.00 parts.
Lead chromate	.30 parts or 1.9%.
Barytes	1.50 parts or 9.4%.
Polyethyleneoxy derivative	.10 part.

Example III

Lithium silicate ($Li_2O:SiO_2=1:3$) in water diluted to sp. g. 1:35	20.00 parts.
Sodium or potassium chromate or dichromate	.10 part or .45%.
Dodecyl benezene sulfate	.15 part.
Fuller's earth	2.10 parts or 9.4%.

Example IV

Sodium silicate ($Na_2O:SiO_2=1:2.8$) in water diluted to sp. g. 1.3	15.00 parts.
Zinc chromate	.25 part or 1.3%.
Powdered mica	4.00 parts or 20.6%.
Nonyl phenoxy polyoxyethylene ethanol	.12 part.

Example V

Sodium silicate ($Na_2O:SiO_2=1:2.8$) in water diluted to sp. g. 1.3	15.00 parts.
Zinc chromate	.25 part or 1.4%.
Graphite	2.00 parts or 11.6%.
Nonyl phenoxy polyoxyethylene ethanol	.12 part.

Satisfactory results are obtained according to this invention with such liquid coating compositions applied by spray, dip, or flow coating, pressure curtain, and like coating procedures to even such hard-to-wet highly polished surfaces as glass, aluminum, magnesium, stainless steel, chromium plating, and the like. Such compositions will dry to full hardness in about five minutes with warm air circulation and/or in a matter of seconds under infrared forced drying to form a protective coating matrix film as desired. Although such coatings achieve a continuous film of a hard and scratch-resistant character, they are

readily removed from the coated part after assembly or when desired by washing with water or steam cleaning, or the like, and, as will be noted, such protective coatings do not contribute to the individual part an unnecessary bulk or clumsiness which would interfere with the shipping or handling or fabrication thereof prior to removal of the coating. Indeed, no disadvantageous results are to be expected even if the coating is not entirely removed after assembly into the structure, as, for example, in the instance where one part is assembled to overlie or lap a coated portion of another coated part.

It will be understood, of course, that the preferred, although not necessary, water solubility of the finished coating is designed for easy removal and, accordingly, for indoor storage and handling. With the particular parts to which this invention is related—whether they be small pieces of polished automobile trim or huge panels or sections for assembly into skyscraper exteriors or rocket missiles—this presents no problem since such materials are, routinely, stored, shipped and handled in a way which protects them from the elements prior to final assembly. As noted, also, the inclusion of water soluble dyes or other coloring matter not incompatible with or disruptive of the inter-relation in synergistic cooperation of the various components of coating compositions embodying this invention is satisfactory for color-coding various different parts for easy identification at the point of assembly into the final structure and without mitigating the various advantages of coatings embodying this invention. Further, the desired scratch-resistant protection is afforded with such compositions at the very point of assembly and in a manner which does not interfere with the appropriate handling and assembly of the various parts, by emphatic contrast to other means of protecting the pre-finished or highly polished surfaces of the coated parts by paper or other wrappings, particularly in instances where such paper wrappings would be removed prior to assembly (i.e., at the very point where scratching or other marring might be expected in handling) and/or where the inability or difficulty of removing such paper or other wrappings after assembly would interfere with the close tolerance interfitting of adjacent parts (i.e., in the situation where there was an overlapping joint between adjacent panels on the exterior of an airframe or rocket missile construction).

In addition to the various illustrative uses or applications noted above for compositions and coatings embodying and for practicing this invention, it may be noted that satisfactory results have been achieved in utilizing such materials for a variety of other protective and covering applications on various surfaces. Thus, formulations embodying this invention possess a high degree of resistance to high temperatures and provide a readily applied and removed "stop-off" coating for such operations as hot dip galvanizing of metals wherein, for example, it is desired to galvanize one surface of a metal part while leaving other surface portions clean or ungalvanized for good paint adhesion. For such uses, coatings embodying this invention are substantially unaffected by being dipped in a molten zinc galvanizing bath even at temperatures as high as 860° F. and shed the galvanizing in those areas of the article covered by the coating.

These coatings also provide protection for metal surfaces from spattering during welding or soldering or brazing by interfering with adhesion of spattered molten metal droplets to exposed surfaces of the article being welded or soldered or brazed, and the liquid compositions of this invention also provide satisfactory adhesive characteristics for use as a readily removable "hold down" adhesive for preliminarily assembling the sandwich layers of metallic honeycomb structure elements for the final brazing thereof into the finished structure. As noted above, variation in the filler composition can be arranged to control the resiliency or flexibility of the coating and also, as will be understood, the coefficient of thermal expansion thereof. With such control the coating may be formulated to achieve a coefficient of expansion approximating that of the coated article, and such coatings also provide substantial and effective oxidation resistance and decarburization resistance for iron and steel articles during heat treatment thereof.

While the compositions and products herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise compositions and products, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. A temporary water-removable and water-soluble, protective and stop-off coating for application to the surface of a metal member to protect such surface from scratching and other marring in handling, shipment, subsequent fabrication and assembly, consisting essentially of a liquid admixture for liquid application to said surface of an aqueous soluble alkali metal silicate in water solution, said silicate having an alkali metal oxide to silicon dioxide ratio of between 1:2 to 1:3 and a specific gravity in the range of 1.3 to 1.4, an inorganic metal salt pigment selected from the group consisting of chromates and dichromates of zinc, lead, sodium, and potassium, and mixtures thereof, present in said admixture in an amount between 0.45% and about 1.9% based on the total weight of said admixture, and an inert and insoluble filler material dispersed in said admixture.

2. A temporary water-removable and water-soluble, protective and stop-off coating for application to the surface of a metal member to protect such surface from scratching and other marring in handling, shipment, subsequent fabrication and assembly, consisting essentially of a liquid admixture for liquid application to said surface of an aqueous soluble alkali metal silicate in water solution, said silicate having an alkali metal oxide to silicon dioxide ratio of between 1:2 to 1:3 and a specific gravity in the range of 1.3 to 1.4, an inorganic metal salt pigment selected from the group consisting of chromates and dichromates of zinc, lead, sodium, and potassium, and mixtures thereof, present in said admixture in an amount between 0.45% and about 1.9% based on the total weight of said admixture, an inert filler material present in an amount between about 9.4% and 20.6% based on the total weight of said admixture, and a surfactant present in a sufficient amount to reduce the surface tension of said liquid admixture for wetting and continuous flowing over said surface of said part.

3. A coating material as set forth in claim 2 wherein said inert filler material is selected from the group consisting of diatomaceous earth, barytes, fuller's earth, mica, graphite, and molybdenum disulphide.

4. A coating material as set forth in claim 2 in which said surfactant is a non-ionic surface active agent.

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