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COATING COMPOSITION AND PROCESS OF APPLYING SAME

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8 Claims. (Cl. 117—6)

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This invention relates to the art of packaging, and more particularly to improved materials for use in packaging equipment to protect it from corrosion over long periods of time.

The export of vast quantities of metal articles has created an urgent need for a means of temporarily protecting such material from the corrosive effects of the elements during transportation and storage prior to actual use thereof, and for longer storage of surplus equipment.

Previous methods of protecting such articles and equipment have involved the use of rust-inhibiting oils and greases applied by brush, spray or dip to the surfaces subject to corrosion. Such methods are limited in their effectiveness because of the resulting poor outdoor durability, ineffectiveness under certain conditions of exposure, such as salt spray at high temperatures, and difficulty of removal, sometimes requiring many man hours, as well as solvents which are difficult to obtain in certain areas of the world.

The Naval Research Laboratory has developed an improved system of packaging, which system includes the following steps:

(1) The equipment is taped to form the general outline of the package.

(2) A webbing composition is applied to form a fabric-like film which envelops the package and serves as a foundation for the topcoat.

(3) An adhesive is next applied to the base of the equipment to seal the later applied topcoat film and provide an airtight package.

(4) A moisture-vapor resistant topcoat is then sprayed to a film thickness of about 40 mils.

(5) A small opening is then made in the package and hot air is blown through it to drive off the solvent fumes and reduce the humidity.

(6) A suitable dessicant and a humidity indicator are next placed inside the package.

(7) A transparent sheet is sealed over the opening in the package to serve as an inspection window through which the humidity indicator can be periodically observed and the dessicant replaced when the inside humidity reaches the danger point.

The webbing operation described in step 2 above consists of spraying a tightly fitting covering, composed of interlaced and overlapping long web-like plastic threads, which bridge across openings rather than pass through them.

Although it has been known for some time that solutions of many materials will veil or cobweb slightly on spraying, it requires a special composition to produce a solution which will have

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unusually good webbing ability, so that a package of the type described above can be prepared.

This invention therefore has as an object an improved webbing composition for use in protecting equipment against corrosion. Another object is the provision of a webbing composition for use in a package which can be easily, cleanly, and quickly removed so that the equipment is readily available for use. A still further object is the provision of a package whose contents can be inspected periodically without opening. An additional object is the provision of an improved method of protecting equipment against corrosion.

We have developed an improved plastic webbing composition which may be formed into long, fine, elastic strings that will bridge large openings, retain their shape so that they can be interlaced to form a fabric-like film suitable for reception of a topcoat, and, with the topcoat, shrink on complete evaporation of the solvents to produce a tightly-fitting fabric-like envelope around the object. These special properties are dependent upon the following factors:

1. Solution viscosity,
2. Resin viscosity,
3. Use of polyvinyl acetate and polyvinyl butyral in proper ratio, and
4. Solvent evaporation rate.

Our webbing composition is preferably sprayed at package viscosity in a pressure spraying system, such as a DeVilbiss MBC gun equipped with an FF tip and a #30 cap. An air pressure at the gun of 50–70 pounds per square inch and a fluid pressure of 10–20 pounds per square inch are suitable. This produces long, fine strings which will hold their shape, are nearly dry upon contacting the object to be packaged, and will shrink to a close fit around the object upon complete evaporation of the solvents.

This webbing serves as the base over which there is then applied, by spraying application, a tough, durable, moisture-vapor resistant, strippable topcoat, to provide the protection for the equipment so packaged.

The topcoat is preferably sprayed at package viscosity in a pressure spraying system, such as a DeVilbiss MBC gun equipped with an E tip and a #70 air cap. An air pressure at the gun of 50–70 pounds per square inch and a fluid pressure of 15–25 pounds per square inch are suitable.

The topcoat is first sprayed to a film thickness of 35 mils. In order to apply a film of this thickness without causing the webbed undercoat to be dissolved in the topcoat and hence coalescing

so that holes are formed in the final film, the spray gun is adjusted so that a "dry" spray is first applied. This strengthens the web coat without dissolving it and allows the application of subsequent "wet" coats until the desired film thickness is reached. This is followed by a second spray application of a pigmented modification of the topcoat to a dry film thickness of about 5 mils. The purpose of applying a final pigmented topcoat is to extend the durable life of the package by protecting it from the actinic rays of the sun.

To anchor the topcoat to the base of the equipment as described in step (3) above, an adhesive is used. When the topcoat is a vinyl chloride type, as shown in Example 3, the adhesive should preferably be a phenol-formaldehyde modified acrylonitrile-butadiene polymer, such as Goodyear Rubber Company's "Pliobond"; with a chloroprene type topcoat, as shown in Example 4, the adhesive should be a cement based on a neoprene-modified chlorinated rubber; and with a nitrocellulose type topcoat, as shown in Example 5, the adhesive should be one based on nitro-cellulose, polyvinyl acetate, or polyvinyl butyral.

Examples of our webbing composition, and of strippable topcoat compositions suitable for use in conjunction therewith, are set forth below by way of illustration and not of limitation:

Example 1

Webbing composition

	Per cent
Polyvinyl butyral (50 centipoises)	7.7
Polyvinyl acetate (60 centipoises)	3.8
Tricresyl phosphate	1.7
Rust-inhibiting oil	2.8
Ethyl alcohol	27.3
Toluene	14.7
Acetone	42.0
	100.0

The webbing composition was prepared by mixing the above ingredients in the proportions shown in a paddle mixer. It had 16% total solids and a viscosity of 27 seconds in a Parlin 15 cup at 25° C. (Viscosity reference: Physical and Chemical Examination of Paints, Varnishes, Lacquer and Color, 9th edition, 1939, page 224, by H. A. Gardner.) This is the equivalent of a viscosity of 600 centipoises.

The rust-inhibiting oil was Rustban 603 oil manufactured by the Standard Oil Company of New Jersey and described in U. S. Patent 2,362,332.

Example 2

Webbing lacquer

	Per cent
Polyvinyl butyral (50 centipoises)	9.6
Polyvinyl acetate (60 centipoises)	1.9
Dibutyl phthalate	2.8
Rust-inhibiting oil	2.8
Ethyl alcohol	38.0
Toluene	20.0
Acetone	24.9
	100.0

The above composition was prepared in the same manner as the composition of Example 1. It had 17.1% total solids and a viscosity of 32 seconds in a Parlin 15 cup at 25° C. This is equivalent to 723 centipoises.

The rust-inhibiting oil was the same as that in Example 1.

The preferred solution viscosity is 27 seconds in a Parlin 15 cup at 25° C. (600 centipoises), although acceptable results can be obtained when the viscosity is 12 to 90 seconds (225 to 2000 centipoises). Higher viscosities reduce the length of the strings, while lower viscosities cause them to retain too much solvent and hence lose their shape on contact with the object.

Although the inherent resin viscosity is not critical, we prefer 40–60 centipoises for the polyvinyl butyral resin and 55–70 centipoises for the polyvinyl acetate resin.

A polyvinyl butyral resin having a viscosity lower than 40 tends to produce shorter and weaker strings on spraying. A polyvinyl acetate resin having a viscosity lower than 55 tends to impair the strippability of the film.

Higher viscosities of either type resin than these indicated objectionably decrease the solids of the solution at spraying viscosity.

Optimum webbing properties are obtained by a combination of these two resins because of their incompatibility. The preferred ratio of polyvinyl butyral to polyvinyl acetate is 2:1, but ratios as low as 1.4:1 and as high as 10:1 produce accceptable results.

The optimum solvent composition is one containing two solvents or groups of solvents, having different evaporation rates, one of which is at least equal to that of acetone (i. e., 720) and the other approximately that of ethyl alcohol (i. e., 203). Although a 50-50 mixture of these types of solvents is preferred, ratios of 70-30 to 30-70 are satisfactory. If more than 70% of the total solvent has a much slower evaporation rate than ethyl alcohol, the webbing strings retain too much solvent and tend to fuse together; furthermore, on drying they shrink excessively and cause many large holes in the envelope. If more than 70% of the total solvent has a much faster evaporation rate than acetone, there is a tendency to form short strings which will not properly bridge large openings.

The rust-inhibiting oil promotes ready strippability of the webbing coat from metal surfaces. Although a ratio of 25% is preferred, the oil may vary between 10% and 40% of the resin.

The tricresyl phosphate acts as a plasticizer for the resin mixture. While 15% of plasticizer is preferred, it may vary between 5% and 25%. Greater quantities than 25% prevent the desired shrinkage characteristics.

Example 3

Strippable topcoat

	Per cent
Polyvinyl chloroacetate resin (88.5–90.5% vinyl chloride)	16.5
Dioctyl phthalate	6.6
Rust-inhibiting oil	4.1
Stabilizer A	0.3
Methyl ethyl ketone	72.5
	100.0

The topcoat composition was prepared by mixing the above ingredients in the proportions shown in a paddle mixer. It had 27.5% total solids and a viscosity of 25 seconds in a Parlin 15 cup at 25° C. (530 centipoises).

The rust-inhibiting oil was the same as in Example 1.

Stabilizer A was a monoglyceride of a fatty

acid obtained from vegetable sources as described in U. S. Patent 2,316,169.

EXAMPLE 3–A

Pigmented strippable topcoat

	Per cent
Polyvinyl chloroacetate resin (88.5–90.5% vinyl chloride)	15.1
Dioctyl phthalate	6.0
Carbon black pigment	2.3
Rust-inhibiting oil	3.8
Stabilizer A	0.3
Methyl ethyl ketone	72.5
	100.0

EXAMPLE 4

Strippable topcoat

	Percent
Polymerized sulfur-modified chloroprene	12.58
Phenyl-β-naphthylamine (anti-oxidant)	0.26
Stearic acid	0.26
Calcined magnesia (extra light)	0.52
Soft carbon black	22.01
"Circo" light process oil (low aniline point)	1.26
Zinc oxide	0.11
Piperidinium pentamethylene-dithiocarbamate	0.15
Toluene	38.00
Xylene	24.85
	100.00

EXAMPLE 5

Strippable topcoat

	Percent
Cellulose nitrate (6 Sec. Hercules[1])	10.00
Tricresyl phosphate	8.00
Mineral oil	0.60
Soya lecithin	0.40
Carbon black	0.90
Zinc oxide	0.50
Hexane	8.00
Acetone	19.90
Ethyl alcohol	11.90
N-butyl alcohol	8.00
N-butyl acetate	31.80
	100.00

[1] ASTM D301–33 Formula A.

Other sprayable, strippable topcoats having good outdoor durability, low moisture-vapor transmission rate, good resistance to corrosion, and high film strength, such as those containing other resins, neoprene or cellulose derivatives, can also be used.

Examples of equipment to which our proposed covering and method of applying same are applicable include military equipment, such as completely assembled anti-aircraft guns, field and coast defense guns, range finders, and searchlights. Peacetime equipment, such as machine tools of all types, including lathes, grinders and milling machines, can likewise be packaged in this manner.

It is apparent that many widely different embodiments of this invention may be made without departing from the spirit and scope thereof; and, therefore, it is not intended to be limited except as indicated in the appended claims.

We claim:

1. A sprayable, strippable, plastic webbing composition comprising a mixture of 1.4–10 parts of polyvinyl butyral resin to 1 part of polyvinyl acetate resin, 5–25% of a compatible plasticizer based on the weight of the resin mixture, 10–40% of a rust-inhibiting oil based on the weight of the resin mixture, and a solvent composition containing at least two solvents, 70–30% of the solvent composition having an evaporation rate equal to that of acetone, and 30–70% having an evaporation rate equal to that of ethyl alcohol, the total solution having a viscosity of 225–2,000 centipoises.

2. A sprayable, strippable, plastic webbing composition composing a mixture of 2 parts of polyvinyl butyral resin to 1 part of polyvinyl acetate resin, 15% of a neutral, non-volatile, non-corrosive ester, plasticizer compatible with the resin mixture based on the weight of the resin mixture, 25% of a rust-inhibiting oil based on the weight of the resin mixture, and a solvent composition containing at least two solvents, 50% of the solvent composition having an evaporation rate equal to that of acetone and 50% having an evaporation rate equal to that of ethyl alcohol, the total solution having a viscosity of 600 centipoises.

3. The composition of claim 2, in which the polyvinyl butyral resin has an inherent viscosity of 40–60 centipoises, and the polyvinyl acetate resin has an inherent viscosity of 55–70 centipoises.

4. The composition of claim 2, in which the plasticizer is tricresyl phosphate.

5. A sprayable, strippable, webbing material having the following composition:

	Percent
Polyvinyl butyral (50 centipoises)	7.7
Polyvinyl acetate (60 centipoises)	3.8
Triscresyl phosphate	1.7
Rust-inhibiting oil	2.8
Ethyl alcohol	27.3
Toluene	14.7
Acetone	42.0
	100.0

6. The process of packaging which comprises applying a strippable plastic webbing composition to the article to be packaged and applying a strippable topcoat composition thereover, said webbing composition comprising a mixture of 1.4–10 parts of polyvinyl butyral resin to 1 part of polyvinyl acetate resin, 5–25% of a compatible plasticizer based on the weight of the resin mixture, 10–40% of a rust-inhibiting oil based on the weight of the resin mixture, and a solvent composition containing at least two solvents, 70–30% of the solvent composition having an evaporation rate equal to that of acetone, and 30–70% having an evaporation rate equal to that of ethyl alcohol.

7. The process of packaging which comprises applying a strippable plastic webbing composition to the article to be packaged, applying thereover a strippable moisture-vapor resistant topcoat having a dry film thickness of about 35 mils, and then applying a pigmented modification of the topcoat having a dry film thickness of about 5 mils, said webbing composition comprising a mixture of 1.4–10 parts of polyvinyl butyral resin to 1 part of polyvinyl acetate resin, 5–25% of a compatible plasticizer based on the weight of the resin mixture, 10–40% of a rust-inhibiting oil based on the weight of the resin mixture, and a solvent composition containing at least two solvents, 70–30% of the solvent composition having an evaporation rate equal to that of acetone, and

30–70% having an evaporation rate equal to that of ethyl alcohol.

8. A corrosion resistant package comprising an article, a strippable plastic webbing coating composition around the article, and a strippable moisture-vapor resistant topcoat thereover, said webbing composition comprising a mixture of 1.4–10 parts of polyvinyl butyral resin to 1 part of polyvinyl acetate resin, 5–25% of a compatible plasticizer based on the weight of the resin mixture, and 10–40% of a rust-inhibiting oil based on the weight of the resin mixture.

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Certificate of Correction

Patent No. 2,480,824 September 6, 1949

CLYDE G. MURPHY ET AL.

It is hereby certified that errors appear in the printed specification of the above numbered patent requiring correction as follows:

Column 4, line 21, for the word "these" read *those*; column 6, line 13, for "composing" read *comprising*;

and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 31st day of January, A. D. 1950.

[SEAL]

THOMAS F. MURPHY,
Assistant Commissioner of Patents.