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PROCESS FOR POLISHING COATINGS

Richard C. Peter, Parlin, N. J., assignor to E. I. du Pont de Nemours & Company, Wilmington, Del., a corporation of Delaware

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This relates to a means for securing a high gloss on coatings applied to surfaces and more particularly on coatings applied to wood surfaces.

In order to obtain glossy, scratch-free surfaces on articles of furniture which have been coated with lacquers, it has been customary to resort to expensive sanding and polishing operations. These operations represent one of the major costs in the finishing of furniture, and in some instances the cost of finally smoothing and polishing the finish approaches that of the cost of materials used including stains, fillers, sealers and lacquers, plus the cost of applying these materials. Usually laborious hand-polishing is used, and this operation is still practiced in the great majority of plants. More recently improvements afforded through the use of machine buffing and polishing were accomplished in some plants. The reduction in cost of polishing has not in many instances equalled the reduction in the cost of materials used, so that the proportion of the cost of finishing an article of furniture is still substantially the same.

This invention, therefore, has as a primary object the elimination of the laborious and expensive polishing of the coated object. A further object is to obtain a higher gloss and fuller, clearer appearance of the coated object. A still further object is to provide a means of securing a surface substantially free from scratches, imperfections, and orange peel markings. Another object is to provide a safe, practical method of accomplishing the previously stated objects. Another object is the elimination of the final clean-up of the coated article, normally made necessary by the presence of excess polishing compound. A further object is the provision of a means of equalizing the gloss when only certain portions of the surface have been sanded to remove orange peel, and particularly in cases where sanding would cut through the coating material at points such as edges, sharply curved areas, and depressed areas. A further object is the provision of a means whereby lacquers which are so tough or soft that they cannot be readily mechanically polished may be used and a gloss and general appearance secured equivalent to that of a highly polished finish from a coating of lesser toughness. A still further object is the provision of a process whereby orange peel and similar surface imperfections may be removed without sanding.

These objects are accomplished by the following invention wherein I apply to an object a coating of finishing material of thickness sufficient for my purpose, then preferably sand the coating to a smooth, wave-free surface, and finally cause a complete flowing-out of the surface by dipping the coated article in a vapor bath of a volatile, organic liquid containing at least one active solvent, whereby sufficient active solvent is condensed and/or absorbed on the surface of the article to give the required glossy appearance to the finish without causing sags or otherwise adversely affecting the appearance of the finish.

The conventional finishing operations applicable to articles such as radio cabinets are carried out in the following manner. The cabinet is first stained with a suitable colored stain which does not raise the grain of the wood. Excess stain is rubbed off and the cabinet is allowed to dry. A coat of suitable filler is then applied by brushing, allowed to flash-dry and the excess rubbed off. After a suitable drying period, a coat of nitrocellulose lacquer sealer such as is described in U. S. Patent 1,973,649 is applied. The coat of sealer when it is thoroughly dried is thoroughly sanded with sandpaper to give a smooth surface upon which I apply the nitrocellulose lacquer coats. Two or three coats of a suitable furniture lacquer are then sprayed and allowed to dry. For the purpose of better illustrating my invention, this lacquer may have the following composition although it will be understood that the example is in no way limitative except insofar that it represents a type of top coat which is susceptible to softening by the action of suitable solvent vapors:

Example 1

	Per cent by weight
Nitrocellulose (¼ sec. viscosity)	10.9
Raw castor oil	1.6
Dibutyl phthalate	2.9
Maleic acid modified rosin ester	10.9
Denatured ethyl alcohol	8.0
Absolute ethyl acetate	5.0
N-butyl acetate	23.0
N-butyl alcohol	4.0
Toluol	33.7
	100.0

When sufficiently hard, the lacquer is sanded with 360 wet or dry sandpaper using napntha or a mixture of naphtha and oil as a lubricating means. This operation gives a smooth surface which is, however, dull due to the scratches from

the abrasive. The excess abrasive and lubricant are then carefully removed.

At this stage the cabinet is ready for the usual polishing operation using first a rubbing compound which comprises an abrasive, such as tripli, mineral oil and kerosene. This is thinned with water or lubricating oil as desired. Following the treatment with the rubbing compound, a final polishing operation is carried out by using an emulsion polish containing an emulsified vegetable oil or a prepared polishing compound containing a mild abrasive and some wax such as "No. 7 Duco" polish and cleaner. These operations tend to leave small amounts of waxy or oily materials on the surface and also tend to leave in the crevices of the radio cabinet appreciable amounts of the abrasive used. This makes necessary a final cleaning-up of the cabinet which is quite difficult to carry out effectively without scratching, and as can be observed in most purchased articles of furniture, traces of these materials will often be found in the crevices.

Through the operation of my improved procedure, I largely avoid this tendency to deposit abrasive and other materials in the crevices, and consider this advantage to be one of the important parts of my improvement.

I, therefore, take the cabinet at the end of the sanding operation and carry out a minor cleaning operation to eliminate traces of abrasive and abraded lacquer left from the sanding treatment, and also make sure that the lubricating oil is substantially completely removed. I then prepare a vapor bath by a suitable means, for instance, I place in an apparatus, such as a vapor degreasing unit, a volatile organic liquid containing at least one active solvent which, when vaporized, has the power of rapidly softening the lacquer film. For example, I may employ methyl ethyl ketone alone, and by heating the container fill the upper portion with undiluted methyl ethyl ketone vapors at a temperature substantially the same as the boiling point of the methyl ethyl ketone itself. Due to the inflammable nature of the methyl ethyl ketone, it is preferable to make use of a non-inflammable mixture. It is a fact, however, that the non-inflammable volatile liquids, particularly the chlorinated hydrocarbons, are not good solvents for nitrocellulose lacquers. It is necessary to blend an active nitrocellulose solvent with a chlorinated hydrocarbon, and in this connection I have found it very convenient to make use of combinations which show an azeotropic binary boiling point. For example, a mixture of 29 parts of methyl ethyl ketone and 71 parts of carbon tetrachloride by weight forms such a mixture. It has also been found that this ratio is particularly effective in that it has a high solvent power for nitrocellulose.

The preparation of the vapor bath is followed by the simple operation of dipping the cabinet by hand or mechanical means into the hot vapors (73.8° C.) until sufficient solvent is absorbed on the surface to provide the desired softening effect without the development of sags or runs. In practice and when working with the cabinet at room temperature, this time of dipping will be found to lie between about ⅕ and ½ of a second when working with the mixture of carbon tetrachloride and methyl ethyl ketone. Using the suggested vapor bath, the finish which has been exposed to the vapors sets up almost as soon as it reaches the air or at least in a minute or two following the removal. It can be seen, therefore, that the process is extremely rapid and that in comparison with the polishing operation, it requires an absolute minimum of labor.

In certain cases where large unwieldy cabinets or other articles of furniture are being treated, the extremely short period of exposure of ½ second is too rapid for practical commercial operation. It is desirable in these instances to make use of volatile, organic liquid compositions of lesser activity prior to the immersion in the vapor to prevent excessive softening of the finish. Another means of reducing the activity is to prepare a mixture of the vapor and air in which, for safety considerations, it is desirable to have the concentration of the vapor well above the upper explosive limit, and to feed this combination into a suitable chamber in which the article of furniture can be immersed. This can be accomplished in a number of ways, for instance, the spraying of the solvent into a moving stream of heated air, flue gas or other inert gas, and through a baffling system in which all of the atomized liquid is removed. The concentration of the solvent vapor required to give effective action is dependent largely upon the activity of the solvent used and the temperature at which the vapor mixture is prepared. The treatment should be controlled for best results so as to obtain only a superficial surface flow in order to avoid running or sags in the finish and to prevent adverse effects on the undercoat.

In handling a mixture of this character, it is very desirable that the system be made as safe as possible and that automatic controls be established to make sure that at no time does the vapor mixture fall within the explosive limits of the solvent in question. Still another method of preparing a vapor bath at lower temperatures below the boiling point comprises heating to boiling the volatile, organic liquid to be used and passing the vapors through a heat exchanger which is kept at a predetermined temperature below that of the boiling point of the liquid. By adjusting the rate of the boiling of the liquid, it is possible to maintain in an upper chamber above this heat exchanger, a suitable concentration of the solvent vapor and at a temperature sufficiently low to permit longer dipping intervals. In this instance, as in the case of spraying the solvent into the air stream, considerable attention must be paid to the keeping of the vapor mixture out of the explosive zone. In order to improve the economics of these alternative methods, it is suggested that the gas-vapor mixtures be recirculated or recovered by condensation.

It will be seen that there are many possible means of securing suitable vapor baths for the operation of my process, and that the preparation of these baths will be controlled by the time necessary to carry out the physical operation of dipping the article into the vapor, removing the same and drying without, first, completely softening the finish, and, second, without causing runs or sags on the object.

It is necessary to avoid too great a softening of the lacquer finish which is usually not over 2 to 3 mils thick and seldom exceeds 5 mils in thickness, because in many cases it has been found that the action of the warm solvents on fillers tends to cause an action known as puffing which is substantially a swelling effect on the filler and causes a very irregular surface on the finished article. It is also important to avoid

too great softening of the lacquer top coats as, particularly in the presence of inert chlorinated hydrocarbons, there is a tendency for the active solvent to disappear in certain cases leaving an excess of the chlorinated hydrocarbons, and this often results in dull, hazy finishes.

The volatile, organic liquid employed in my invention to produce hot vapors for producing high gloss and removing surface irregularities may include, for example, acetone, isopropyl acetone, methyl ethyl ketone, methyl propyl ketone, methyl acetate, ethyl acetate, isobutyl acetate, methyl and ethyl ethers of ethylene glycol and their acetates, benzene, toluene, gasoline, trichlorethylene, ethyl alcohol, propyl alcohol, butyl alcohol and other similar volatile, organic liquids, which may be used in various combinations and proportions depending upon the type of coating to be treated. In any event it is imperative that the volatile, organic liquid contain at least one component which is an active solvent for the organic coating to be treated. For safety reasons it is desirable to include also a suitable proportion of a non-inflammable component to reduce fire and explosion hazards.

Excellent results have also been obtained in applying the process to certain pigmented finishes on metal bases, where the step of pre-heating the coated article has been advantageous. The following example illustrates the applicability of the process for coated metal objects.

Example 2

	Per cent by weight
Nitrocellulose (¼ sec. viscosity)	6.9
Damar resin	1.7
Synthetic resin*	1.7
Dibutyl phthalate	1.6
Blown castor oil	0.9
Carbon black pigment	1.1
Denatured ethyl alcohol	8.7
Methyl ethyl ketone	9.5
Normal butyl acetate	24.3
Normal butyl alcohol	5.8
Toluol	37.8
	100.0

*The synthetic resin used in this example consisted of the reaction product of:

	Per cent by weight
Glycerine	16.2
Phthalic anhydride	36.6
Cottonseed oil	47.2
	100.0

and was prepared in accordance with procedures well known in the art.

This composition which is shown on a ready to spray basis was sprayed (3 coats) on a metal panel which had been previously coated with a conventional oleoresinous primer and surfacer in accordance with standard metal finishing practice. The panel was then force dried at 93° C. and immersed directly without cooling (and omitting the customary sanding step to remove surface irregularities) in the hot vapors of a mixture of absolute ethyl acetate, 15 parts by weight and specially denatured alcohol (23—A), 85 parts by weight in a container heated exteriorly so that the temperature of the vapors was 73.5° C. At the end of about 3 minutes, a definite improvement in gloss of the finish was observed but surface irregularities still persisted. After about 7 minutes immersion, the gloss was still further improved and in addition orange peel pattern was less evident. At the end of 10 minutes immersion in the hot vapors of the solvent mixture, orange peel pattern and other surface irregularities were substantially completely removed and a very high gloss was apparent.

In general, in practising the invention for coatings applied to metal articles it is desirable, particularly when sanding is omitted, to preheat the article to a temperature at least that of the hot vapors of the volatile organic liquid to avoid excessive condensation with too great softening of the film.

My process is not limited to furniture as it can be readily used for a polishing effect on metal or other objects which have been previously coated with a suitable top coat material. Also, I am not limited in the type of top coat used except in that I must work with a coating material which has dried substantially by evaporation. Therefore, paints, varnishes and many synthetic resin finishes are not suitable for use in this connection because in the setting up of these finishes there has occurred a chemical change, such as oxidation or polymerization, which has greatly altered the solubility of the film, and when the newly formed film is attacked by the solvent vapor, wrinkling and many other serious defects are brought about. Numerous tests have failed to produce substantial increases in gloss on coatings of this type. Among the types of finishes which can be used in my process are the cellulose ester and ether lacquers and enamels, chlorinated rubbed finishes, vinyl resin compositions and cellulose derivative lacquer emulsions.

The new process is of particular advantage in that it affords material operating economies by the elimination of the laborious and time-consuming hand or machine polishing operations now practiced in the industry. The final gloss and appearance of the finish treated in accordance with the process of the invention is superior to that produced by conventional methods. Furthermore, greater uniformity in gloss is assured since the new process effectively produces gloss in depressions in the finish which are quite difficult to polish by the usual polishing operations. The step of final clean-up required by previous practice to remove excess polishing compound is eliminated, thus furthering the economic advantages of the invention. The improved process is preeminently suited for developing desired gloss on edges, depressions and sharply curved areas of irregularly shaped articles where prior practice is not adapted in producing the desired results. The invention is of particular utility also in securing a high gloss on finishes which are so tough or so soft as to prohibit the effective use of conventional friction polishing methods.

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.

I claim:

1. In the process of imparting a high luster to an article coated with a thin film of a cellulose derivative coating composition which is capable of re-solution, the improvement which comprises subjecting the said finished article momentarily to an atmosphere of hot concentrated vapors of a binary azeotropic mixture of a chlorinated hydrocarbon and methyl ethyl ketone.

2. The process of claim 1 in which the chlorinated hydrocarbon is carbon tetrachloride.

RICHARD C. PETER.