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PAINT BAKING PROCESS

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The object of my invention is to provide a paint drying process particularly adapted for use in connection with the painting of automobile bodies. This class of work presents certain difficulties not encountered in painting small objects, which difficulties have limited the scope of paints applicable to this class of work.

Quite a number of years ago it was customary to use air drying color varnish for painting automobile bodies; however, this material was several years ago superseded by lacquer because of the latter's much greater durability. Durability is, of course, a prime requisite for such finishes but is not the only factor. This may be brought out by the fact that during the era when color varnishes were being extensively used a baked enamel was also available and was used to a limited extent. This enamel finish was far superior in durability to either the color varnish or the lacquer which superseded it, but had the disadvantage that flaws, scratches or other imperfections could not be corrected. It was required that the enamel be applied to the body before the upholstery, glass, hardware or other fittings were installed, because the enamel had to be baked at about 300° F. for several hours.

The former practice in using baking enamel was to fabricate the body entirely of metal, then after the preliminary sanding and cleaning operation the enamel was either sprayed or blown on the surfaces to be enameled and then the body was placed in an oven at approximately 300° for several hours, depending upon the enamel used. The car body was then upholstered, all the instruments installed, the door handles and hardware secured in place and all mounted upon the chassis. It will be seen that most of the work on the body was performed after enameling and consequently great care had to be used in assembling the various fittings to insure that the enamel surface was not scratched or marred, as such a marked surface would prevent the sale of the car. In spite of the great precaution taken where baked enamel was used, a small percentage of the bodies invariably became scratched so that the upholstery, glass, instruments and hardware had to be removed and the body sanded down and reenameled. This reenameled operation was very expensive and even though only a small percentage of the cars finished were marred, still the great cost in repairing even this small percentage counteracted the gain in the use of enamel.

For the above reason, baked enamel was only used to a very limited extent on automobiles, al-

though it produced an excellent finish both in appearance and in durability.

The automobile industry required a finish which was not only durable but which could easily be applied, preferably after the bodies were upholstered, and one which could be repaired without excessive cost. For this reason lacquer soon superseded both baked enamel and color varnish. Although lacquer finishes are comparatively easy to apply they require rubbing to produce the necessary gloss and consequently the cost of finishing an automobile body with lacquer is considerable. However, this extra cost is more than offset because the lacquer may be applied after the upholstery and glass have been installed in the car so that in case the car is scratched during the assembly of the hardware thereon the scratched surface may readily be repaired, as no heat is required to dry same. In this connection no rubbing is required on an enameled surface.

It is the purpose of this application to describe a new drying process for baking enamel which may be employed after the glass and upholstery have been installed in the body so that scratches and mars of all descriptions may be repaired without the removal of the upholstering, glass or other equipment of the car and with no greater expense than is the case by the repair of a lacquered finished car.

While my improved process may not be commercially applicable to all classes of work, still it is believed that marked savings can be made by the use of my improved process for reenameled portions of automobile bodies which have become marred.

It should be kept in mind that my improved method of drying is not accomplished by the substitution of an inferior or lower temperature drying enamel for the desirable high temperature drying enamel heretofore used, nor is it accomplished by applying a lighter coat of enamel. The recommended procedure in using my drying process is to apply identically the same baking enamel as would be used if the body were to be baked at 300° F. for several hours, using the same number of coats of enamel. Thus, identically the same body finish will be produced on the repaired surface as on the adjacent surfaces so that there will be no difference in the appearance of the repaired and original finished portions of the car. It will further be well to keep in mind that while the total baking time in my improved process is only approximately five minutes, in contrast to several hours required to bake the same enamel by the ordinary process, still the

intensity of the heat used in my process is even less than that of the ordinary enamel baking oven. At no time does the temperature used in my process reach 300° F. as heretofore required.

5 The important feature of my invention, and the feature which makes it possible to dry enamel in five minutes at a lower temperature than formerly required two to three hours of baking, is that the wave length of the heat used in my
10 process is selected so that a penetration is obtained which is most advantageous for the average thickness of the enamel coating being applied.

Before describing the theory believed applicable to my process, it may be well to describe the exact operations employed in carrying out my process. This process will be described as a "repair" process, however, if electrical energy is sufficiently cheap it may be advantageous to
20 use the process for initially finishing the entire car body. Further, this process being adapted for use without removing the upholstery from the car is applicable for refinishing cars or for initially finishing cars having composite bodies.

25 The desirable operations in repairing a panel which becomes scratched comprises:

1. Sand with No. 400 silicon carbide paper and water, completely sanding the panel that the repair spot occurs in. The sanding should be
30 thorough enough to remove all dirt and orange peel.

2. Thoroughly clean the panel with water and subsequently dry same.

Masks should be placed on the adjacent panels
35 that are apt to be fogged when spraying the enamel on the repair panel. The actual spraying operation should be done by using the same color and type of enamel as was sprayed on the part originally, spraying the same number of
40 coats on the repaired panel that was sprayed on those panels adjoining the repaired panel to thus give the same color and luster on all panels.

After the required number of coats have been applied, place a drying unit, which will subsequently be described, from 12 to 18 inches from the repaired panel, and heat the enamel for about
45 five minutes, the exact drying time, depending upon the size of the drying unit employed.

It will be seen from the above that the only
50 novel feature of this process comprises the drying operation and that this operation requires the use of a special drying unit. However, the applicant makes no claim to have invented the heating elements in his drying unit, as same can be
55 readily purchased from most electrical supply houses. However, he does claim that inasmuch as the results obtained in drying enamel with these elements are so unexpected that the use of the specific wave length band emitted by these
60 elements in drying enamel is patentable. The applicant is unaware of any other occasion where such heating elements have been used for drying enamel by direct radiation.

The applicant's drying unit is preferably constructed by mounting a plurality of carbon filament lamp bulbs in a flat plane, with a reflector in back of each bulb. These reflectors should focus the rays emitted by the bulbs forwardly with a slight spread so that the light pattern is
70 substantially uniform at from one to two feet in front of the bulbs. The bulbs may be mounted in a portable frame which can be placed alongside of the panel to be repaired. For use in repairing whole side panels of sedan-type bodies,
75 the applicant has found that 85 carbon filament

bulbs of 260 watt capacity and 50 candle power each are sufficient to dry the enamel in five minutes. For smaller panels fewer bulbs may, of course, be used. It is desirable that the bulbs be placed about 18 inches away from the panel
5 and that the light pattern be substantially uniform over the whole panel being enameled.

A very important characteristic of my improved method of drying is that where either plain glass or safety glass is used in the windows and doors of the body, such glass need not be removed from the body when it is being repaired. It is only required that the glass be run up so as to close the window or door openings and be directly exposed to the rays from the
10 drying unit. For some reason not known to the applicant, neither plain glass nor safety glass is in any way harmed by the heat rays from the drying unit just described, although enamel is rapidly dried by such rays. If the glass is lowered
15 into the doors or body the heat is sufficient to almost immediately crack plain glass or discolor the safety glass. It would ordinarily be expected that glass "protected" by the door panel would be less affected by the heat rays from the unit
20 than when directly exposed to same, however, this also is an unexpected result of using such heating elements for drying enamel. It is, of course, impossible to run a body with the glass installed through any kind of an enamel baking
25 oven known to the applicant without cracking the glass long before the enamel is dry. In fact, other types of portable heating units have been tried in place of the device described but with all of such units, the glass invariably cracked
30 long before the enamel had become dry. Furthermore, the most intense heat which could be maintained from a resistance wire-type heater, without blistering the enamel, took several hours to dry the enamel while the carbon bulb-type heater described dried the same enamel in less
35 than five minutes with apparently less heat and with no blistering whatever.

It is not known definitely what causes the remarkable results obtained with this process, however, the following explanation may be correct and is given as a possible solution.

When heat rays fall upon any substance, part is transmitted through the substance, a part absorbed and a part reflected. The reflected part is immaterial here but the parts transmitted and absorbed are believed to be important, depending upon the wave lengths of the radiation and upon the character of the substance. By transmission is meant the penetration through the substance at a particular depth and by absorption is meant the stoppage of the heat waves within the particular depth. It is believed that with the carbon filament bulb as a heating unit, wave lengths are projected, a large percentage of which
55 penetrate almost through the layer of enamel so that surface heating is retarded while at the same time the penetration dries the enamel uniformly over its full depth.

Several sources of radiation are available, namely, the iron wire heater at about 1350° F.; the carbon filament lamp bulb at 3400° F.; the tungsten filament bulb at about 5000° F. and the sun's radiation, 9500° F.

The percentage of the total radiation penetrating to any particular depth in any substance varies widely for the above sources of radiation. Further, the maximum transmission through water for wave lengths is about 11,000 A while for other substances the maximum penetration is
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obtained at other wave lengths. Consequently, in deciding the wave lengths which are most desirable to use, it is necessary to learn the transmission characteristics of the substance being heated and from the thickness of the substance and its transmission curve can be calculated the wave length which will penetrate almost to the bottom of the coating without dispersing itself in the metal upon which the enamel is applied.

It is just as important that too great a penetration be avoided as that surface heating be avoided. The absorption by liquids is not proportional to the depth, as the first mm. may transmit only 10% of the total radiation while the next mm. will transmit 90% of the radiation penetrating to its depth. This is due to the fact that a very large amount of the energy reaching the first surface is not transmitted at all but is absorbed on the surface, while for radiation of wave lengths corresponding to the transmission band a very large percentage that reached the first surface may pass through the first mm. and a large percentage of this through the second mm. It is therefore important that a wave length be chosen which will penetrate to a point near the bottom of the enamel without excessive penetrating through to the metal underneath.

The following table is given to show the penetration of different sources of radiation through water, as such information is not yet available to the applicant for baking enamel. However, the results of experiments leads one to believe that the penetration through enamel is about one-half that through water. At any rate, the ratios should be substantially the same.

Transmission and absorption for radiating sources

Depth	Iron wire 1350° F.		Carbon lamp 3400° F.		Tungsten lamp 5900° F.	
	Trans.	Absorp.	Trans.	Absorp.	Trans.	Absorp.
	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent	Per-cent
Surface.....		96.9		65		35
1 mm.....	3.1	2	35	14	65	6
2 mm.....	1	.35	28	7	59	5
3 mm.....	.65	.10	24	4	54	2
4 mm.....	.55	.05	22	2	52	1
5 mm.....	.5		20		51	

From the above it will be seen that 96.9% of the energy of a radiating source at 1350° F. is absorbed at the surface or before the radiation reaches 1 mm. while only 65% of the radiation from a source at 3400° F. is absorbed by this penetration. Furthermore, only 2% of the total iron wire radiation is absorbed at 1 mm. while 14% of the carbon lamp radiation is absorbed at this depth.

Consequently, maintaining the same surface temperature about ten times the absorption at 1 mm. depth occurs with the carbon lamp radiation than with the iron wire radiation. As this is about the depth of a coat of enamel the reduction in the drying time is obvious.

While radiation from a tungsten lamp is more penetrating there is no advantage to be gained by using same because twice the radiation must be applied to obtain the same surface temperature as with the carbon lamp which double radiation has only the same absorption at 1 mm. depth, the excess penetrating through the enamel and even through the metal panel itself.

The applicant has found that a carbon fila-

ment lamp of 260 watts and 50 candle power radiates energy, the maximum portion of which is in the near visible infra red range or between 10,000 A and 16,000 A (1.00 to 1.6 microns). This radiation is distinguished from an open resistance wire heater which radiates energy which is characterized by being composed of wave lengths of from 20,000 A to 100,000 A.

It may in the future be found that some reason, not now known to the applicant, is responsible for the remarkable results obtained with his improved process, however, such reason is of only secondary importance as the directions given herein are believed ample to enable one to practice this process and obtain the advantages thereof.

Among the many advantages arising from the use of my improved paint baking process, it may be well to mention that a single body panel may be baked thereby without removing the glass, instruments or upholstery from the car, which result was heretofore believed impossible with any other enamel baking process.

Furthermore, the baking time required is only a fraction of the time formerly required so that the operation can be carried on in most garages or service stations.

Still further, comparatively inexpensive equipment is only required so that garages may commercially be equipped with such device.

Some changes may be made in the several steps comprising my improved process without departing from the spirit of my invention and it is my intention to cover by my claims such changes as may reasonably be included within the scope thereof.

I claim as my invention:

1. The process of baking enamel consisting of exposing a surface coated with said enamel to radiation, the major portion of which is of a wave length within the near visible infra-red portion of the spectrum and of a length less than 1.6 microns.

2. A method of enameling comprising, coating a surface with liquid enamel, and then exposing said coated surface until dry to radiation, the major portion of which is of a wave length within the near visible infra-red portion of the spectrum and of a length less than 1.6 microns.

3. A method of repairing a defective baked enameled surface on an automobile body comprising, removing the enamel from said defective surface, then sanding and cleaning said surface, then coating said surface with identically the same enamel as was applied to the remainder of said body, applying the same number of coats thereto, and then exposing said repaired surface to radiation, the major portion of which is of a wave length within the near visible infra-red portion of the spectrum and of a length less than 1.6 microns.

4. The method of repairing a defective baked enameled surface on a closed type automobile body comprising, removing the enamel from said defective surface, then sanding and cleaning said surface, then coating said surface with identically the same enamel and number of coats as was applied to the remainder of said body, and then exposing said repaired surface for substantially five minutes to radiation, the major portion of which is of a wave length between 1.6 and .6 microns, the glass windows of said body adjacent to said repaired panel being raised during said exposure so as to be directly exposed to said radiation.

5. The method, as claimed in claim 4, wherein the enamel applied to said surface normally requires an exposure of at least one hour at 300° F. black body heat to bake same.
- 5 6. The process of baking an enamel or similar coating consisting of exposing the coated article to reflected radiation, the major portion of which lies within a wave band between 1.6 and .6 microns.
- 10 7. The process of baking an enamel or similar coating consisting of, exposing the coated article for substantially five minutes to reflected radiation, the major portion of which is of a wave length between 1.6 and .6 microns.
8. The method of repairing a defective baked enamel surface on a closed type automobile body comprising, removing the enamel from said defective surface, then sanding and cleaning said surface, then coating said surface with enamel similar to the original enamel, and then exposing said repaired surface for substantially five minutes to reflected radiation, the major portion of which is of a wave length between 1.6 and .6 microns, the glass windows of said body adjacent to said repaired panel being raised during said exposure so as to be directly exposed to said radiation.

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