Oct. 20, 1936. F. J. GROVEN 2,057,776

PAINT BAKING APPARATUS

Filed Oct. 29, 1934

Fig. 1.

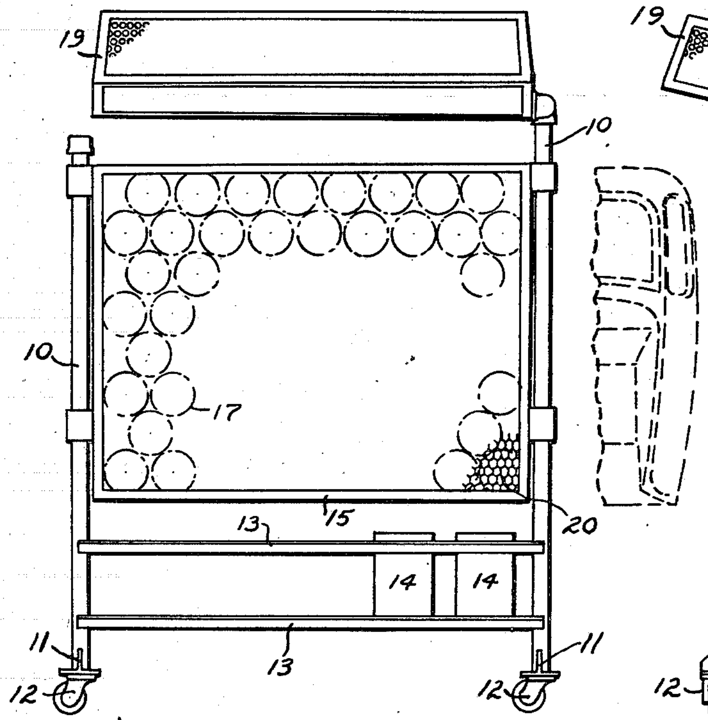
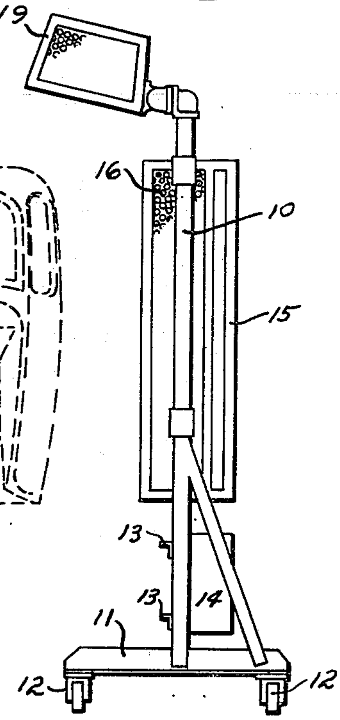


Fig. 2.



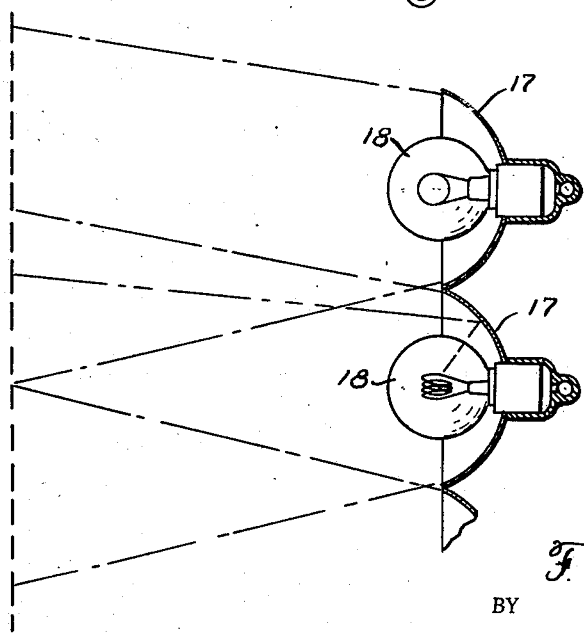


Fig. 3.

INVENTOR.

F. J. Groven.

BY

ATTORNEY.

Edwin C. McRae

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PAINT BAKING APPARATUS

Fredrick J. Groven, Highland Park, Mich., assignor to Ford Motor Company, Dearborn, Mich., a corporation of Delaware

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2 Claims. (Cl. 219—45)

This application is a continuation in part of United States application, Serial No. 681,567, filed July 21, 1933, now Patent Number 1,998,615.

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customary to use air drying color varnish for painting automobile bodies; however, this material was several years ago superseded by lacquer because of the latter's much greater durability.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 This enamel finish was in many ways superior to either the color varnish or the lacquer which superseded it, but had the disadvantage that flaws, scratches or other imperfections could not be corrected.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 flowed 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 reenameling 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, although it produced an excellent finish both in appearance and in durability.

The automobile industry requires a finish which is 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 finish 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 reenameling 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, the 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.

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 process is selected so that a penetration is obtained which is most advantageous for the average thickness of the enamel coating being applied.

With these and other objects in view, my invention consists in the arrangement, construction and combination of the various parts of my improved device, as described in the specification, claimed in my claims, and illustrated in the accompanying drawing, in which:

Figure 1 shows a front view of a drying unit adapted to dry a side or rear portion of an automobile body.

Figure 2 shows a side view of the device shown in Figure 1, and

Figure 3 is a diagrammatic view illustrating the positioning of the heating bulbs relative to the reflectors and to the painted surface being dried.

Referring to the accompanying drawing, I have used the reference numeral 10 to indicate generally a pair of vertically extending upright posts, each of which is provided with a cross bar 11 at its lowermost end. Upon the outer end of each cross bar 11 a castor 12 is mounted so that the posts may be conveniently moved from place to place. The two posts 10 are attached together by means of angle iron bars 13, these bars also supporting the switch boxes 14 which control the heating units about to be described.

The heating units are mounted within a rectangularly shaped frame 15, this frame being constructed of angle iron and being provided with sides and rear formed of perforated metal 16 while the front face is covered with wire screen 20 of approximately one inch and a quarter mesh, the screen being commonly known as chicken wire. Mounted within the frame 15 I have provided 68 reflectors 17 in each of which a 260 watt, 50 candle power carbon filament lamp bulb 18 is disposed. It will be noted from Figure 3 that the bulbs are placed in the reflectors so that the reflected rays have a considerable spread. Best results are obtained by using reflectors of approximately seven inch diameter and focusing the bulb so that an area of approximately fourteen inches in diameter is covered at a foot and one-half distance. The surface to be dried is placed substantially 18 inches away, and consequently the reflected light from each of these bulbs overlaps sufficiently to produce a uniform heat over the full surface being dried.

It will be noted from Figures 1 and 2 that I have provided a second frame member 19 which is provided with seventeen reflectors and bulbs, similar to the units shown in Figure 3, this frame being mounted so as to focus the heat rays downwardly upon the upper corner of the body being dried.

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 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.

The desirable operations in repairing a panel which becomes scratched comprise:

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

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

3. Masks should be placed on the adjacent panels 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 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.

4. After the required number of coats have been applied, place the drying unit just described 12 to 18 inches away from the repaired panel, and heat the enamel for about five minutes, the exact drying time depending upon the size of the drying unit employed and area to be dried.

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 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 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 units 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 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 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 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, energy is projected of such wave length that a large percentage penetrates 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, 9,500° 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 permeability through water occurs at wave lengths of about 11,000 A. while for other substances the maximum penetration is 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 1,350° F.		Carbon lamp 3,400° F.		Tungsten lamp 5,000° F.	
	Trans.	Absorp.	Trans.	Absorp.	Trans.	Absorp.
	Percent	*Percent*	*Percent*	*Percent*	*Percent*	*Percent*
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 1,350° F. is absorbed at the surface or before the radiation reaches 1 mm. while only 65% of the radiation from a source at 3,400° 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 thickness 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 filament 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 other enamel baking processes.

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, my apparatus is comparatively inexpensive so that garages may commercially be equipped with such device.

Some changes may be made in the apparatus and 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. An apparatus for drying enamel or a similar coating upon motor vehicle bodies comprising, a rectangular shaped frame, the sides and rear of said frame being covered with perforated metal, means for adjustably supporting said frame for movement in a vertical plane so that same may be raised or lowered to position substantially horizontally aligned with the enameled surface to be dried, a plurality of sockets fixed in said frame, a reflector associated with each of said sockets, a carbon filament lamp bulb disposed in each of said sockets, said reflectors being arranged in staggered relationship so as to occupy the major portion of the space within said frame, said bulbs being arranged in said reflectors so that said re-

flectors reflect the rays from said bulbs through the front side of said frame, and an open mesh wire screen disposed over the front of said frame so as to protect said bulbs.

2. A device, as claimed in claim 1, wherein a second frame member is supported above said first mentioned frame, said second mentioned frame having a plurality of reflectors and lamp bulbs disposed therein in position to focus the rays therefrom downwardly upon one upper corner of the roof of said body being enameled.

FREDRICK J. GROVEN.