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DIE-FORMABLE BLANKS FOR AUTOMOBILE BODY PARTS AND THE LIKE

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Fig. 1.

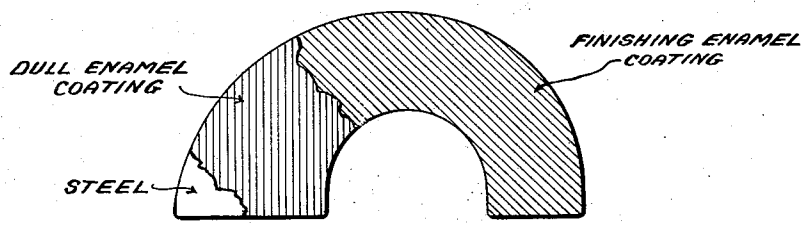
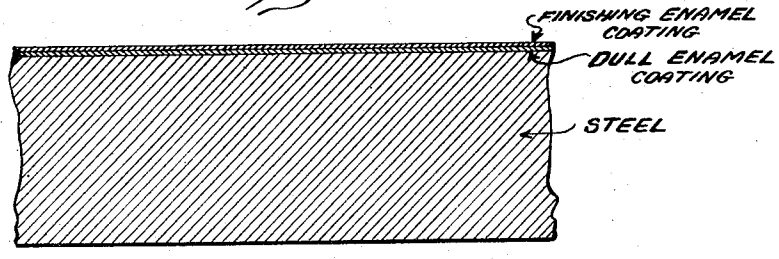


Fig. 2.



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DIE-FORMABLE BLANK FOR AUTOMOBILE BODY PARTS AND THE LIKE

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9 Claims. (Cl. 117—75)

This invention relates to die-formable blanks for automobile body parts and the like, including not only parts of the body proper, but also fenders and hoods, which, like the parts of a body proper, are made of steel plates and provided with a weatherproof gloss finish.

The object of the invention is to provide for making better parts at a substantial saving in expense.

Automobile body parts are made of heavy steel plates, 16 to 24 gauge plates, and are given their required shape by severe die-forming operations in which very heavy pressures are applied to the surfaces of the plates to distort them and frequently to bend them on short radii, so that their surfaces are substantially stretched or contracted—often as much as 30%. The finish required on automobile body parts cannot be obtained by applying a gloss or finishing enamel directly to the metal. In order to obtain the necessary adherence and the desired appearance and durability in the finish, the finishing enamel is applied over a rust-inhibitive undercoat having a smooth but dull surface. According to present practice, such an undercoat is obtained by applying to die-formed parts of irregular form, by hand-spraying or by dipping, one or more coatings of priming and filling compositions. When the application is by hand-spraying, about half the coating composition is wasted and the coats have irregular surfaces which are sanded by hand in order to obtain a surface sufficiently smooth for the application of the finishing enamel. The cost and waste of the hand-spraying and sanding operations are important items in the cost of the finished body parts made by such methods. When the application of the priming coat is by dipping, the coating is irregular in thickness, so that the finish of the parts lacks durability at the places where the priming coat is thinnest.

Our invention produces durable finished body parts at a very substantial reduction in cost by providing an undercoat of uniform thickness having the dull but smooth surface required for the application of a finishing enamel, without sanding or other manual operations.

A die-formable blank embodying our invention consists of a flat steel plate of from 16 to 24 gauge having on one of its surfaces a smooth, uniformly thick, dull-surfaced, adherent coating of highly-pigmented enamel which is ductile, so that it is not cracked or injured by subjecting the blank to the die-forming operations customarily used to form a steel plate into an automobile body part. In the preferred embodiment of our invention, the blank has, over the dull coating, a gloss coat of finishing enamel which is ductile.

By a "ductile" coating, we mean a coating which, while solid, neverthless has the capability of flowing without rupture, so that, when the coating is applied to a steel plate, such for example as a 16 gauge plate of 60 mils thickness, it is not cracked, broken or in any way injured by the stretching or contraction of the surface of the steel plate which occurs in die-forming operations. This means that the ductility of the coating on the metal is such that it is capable of an elongation or contraction of at least 30% without fracture. We have discovered that this quality of ductility, which should be distingiushed from mere flexibility, is possessed by some known gloss enamel coatings, but not by coatings of the priming and filling compositions which are being used under such enamels. Our researches have led us to the conclusion that the condition of the pigment is a factor of great importance in determining the ductility of a coating. We have found that, no matter how highly plasticized the binder of a coating may be, the coating cannot be stretched without injury if irregular strains are set up by the presence of pigment agglomerates or flocculates or incompletely wetted pigment.

Ordinary enamels have their pigment in a fine, deflocculated, completely-wetted condition which is recognized as essential in order to obtain a gloss surface. In this enamel condition, the pigment does not set up irregular strains on the stretching of the binder. The volume ratio of pigment to binder is, as a rule, not over 1:9. Some such enamels have flexible binders, and these, we have found, make coatings having the property of ductility.

We have found that the volume of pigment in an enamel may be increased to approximate equality to the volume of the binder without changing the condition of the pigment usual in enamels, so that in the dried coating the increased volume of pigment does not set up irregular strains in the binder when the coating is stretched. The increased pigmentation therefore does not interfere with the ductility of the coating, but gives the coating a dull rather than a gloss surface, so that an ordinary finishing enamel will adhere firmly to it.

By roll-coating a flat steel plate with a highly-pigmented enamel, we are able to provide a practical coated plate which can be subjected to die-

forming operations without injuring the coating, and thus to avoid the disadvantages inherent in applying coatings to preformed parts of irregular form.

To clarify further the nature of our invention, we will describe in detail an illustrative embodiment of it which is shown in the accompanying drawing. The drawing shows a blank for an automobile fender:

Fig. 1 is a plan view of the blank with parts of its coating broken away; and

Fig. 2 is a fragmentary transverse section of the blank.

The die-formable blank shown in the drawing consists of a flat steel plate of from 16 to 24 gauge (60 to 25 mils in thickness) having a dull-surfaced undercoating of a thickness of from ¼ to 1 mil and a gloss-surface outer coating of from 0.8 to 1.5 mils thickness. The coatings are formed by mechanically applying to the plate, most desirably by means of a roll-coating machine, first a highly-pigmented, dull enamel and then a normally-pigmented enamel. Both coatings are ductile, as that word has hereinbefore been defined, and so are capable when on the metal of as much as a 30% stretch without fracture. In the specific fender blank illustrated in the drawing, the steel plate is 20 gauge, the undercoating is ½ mil in thickness, and the outer coating is 1 mil in thickness.

The enamel used for the first coating has a flexible, metal-adherent binder highly pigmented with rust-inhibiting, covering and filling pigment. As a specific example of a suitable dull enamel for the first coating, we cite the following:

A paste is made by mixing the following ingredients:

	Parts by weight
Venetian red	60.0
Zinc-chromate (pH value 6.5)	6.7
50% solution of oil-modified alkyd resin in hi-flash naphtha	23.3
Hi-flash naphtha	10.0
	100.0

This paste is ground, preferably in a steel ball mill, until the pigment is fully deflocculated and wetted. A minimum of 36 hours of such grinding is required, according to our experience, to put the pigment into enamel condition. The paste is then thinned by additional solvent and additional binder to the following composition:

	Parts by weight
Pigment (deflocculated):	
Venetian red	34.0
Zinc chromate	3.8
Binder	
Oil-modified alkyd resin	22.5
Solvents	
Hi-flash naphtha	36.7
Terpene "B" hydrocarbon	3.0
	100.0

This enamel composition is applied to a steel plate by a roller-coating machine which is regulated to lay a coating of from ½ mil to 2 mils in thickness, so that the dried coating will have about half this thickness.

The oil-modified alkyd resin specified in the above formula is made by reacting 126 parts of glycerol, 195 parts of phthalic anhydride, 85 parts of soya bean oil acid, 47 parts of dehydrated castor oil acids, 27 parts of soya bean oil and 27 parts of dehydrated castor oil in conventional manner to form a low-acid resin, reducing to 50% non-volatile with hi-flash naphtha, when an acid number of 5 to 10 is attained.

The hi-flash naphtha specified in the above formula is a coal tar distillate having a boiling range of about 150° C.–200° C.

The terpene "B" hydrocarbon specified in the above formula is a pine oil derivative produced as a by-product in the manufacture of synthetic camphor, whose approximate composition is terpinen 25.4%, terpinolene 63.4% and dipentine 11.2%.

The oil-modified alkyd resin binder specified in the above example is a flexible resinous binder which is metal-adherent, that is, it has such affinity for metal as to adhere to it strongly. It may be replaced by other binders known to have these characteristics, such as oleo-resinous binders and plasticized chlorinated rubber binders.

The zinc chromate is a rust-inhibitive pigment. We have found it the most satisfactory of known rust-inhibitive pigments, but it may be replaced by other pigments of this class, such, as for example, the commercial grade of red lead known as "orange mineral."

The Venetian red is a natural iron ore pigment containing approximately 25% of iron oxides and 75% of mineral filling pigments. It may be replaced with other iron-oxide-bearing pigments such as burnt umber or burnt sienna, or by other filling or covering pigment which may be deflocculated and fully wetted by the binder. We prefer, however, to use pigments containing oxides of iron, as they have rust-inhibiting properties and are susceptible of complete deflocculation.

The enamel specified in the example is highly pigmented. The volume ratio of total pigment to total binder is approximately 2:3. Although the volume of pigment is nearly equal to the volume of binder, it is low enough to permit retaining the pigment in enamel condition, so that a ductile coating is produced. This enamel condition has the additional advantage of making the coating impermeable so that it cannot absorb a finishing enamel applied over it. The enamel condition of the pigment also has the advantage of avoiding voids in the dried coating, and thus enables the coating to withstand the pressure of the dies without collapse or thinning. The pigmentation is high enough to give the coating a dull surface, notwithstanding the enamel condition of the pigment. The high pigmentation gives the enamel the body required to fill and smooth over scratches in the surface of the steel, so as to provide a smooth surface for the application of a finishing enamel. Some variation in the proportion of pigment may be made without losing any of these important characteristics of the coating, but the volume ratio of pigment to binder should, in general, be between 1:3 and 1:1.

If the dull enamel made in accordance with the above formula be modified by reducing the volume ratio of pigment to binder to a ratio of 1:9, common in enamels, without making any other change in the composition, a film with a gloss surface will result. This shows that the pigment is in enamel condition and the composition is a true enamel in spite of its dull surface.

After the dull enamel composition is coated on the steel plate, the plate is baked to set the binder of the coating. With a coating of the formula given above, this may be effected by subjecting

the coated plate to a temperature of about 400° F. for about 12 minutes. The drying of the coating reduces the thickness of the applied coating about one-half, so that the thickness of the dry coating is from one-quarter to one mil. This is thick enough to fill and cover scratches in the surface of the steel plate and to give the full bodied appearance required after a finishing enamel is applied. At the same time, it is thin enough to have the required ductility.

The enamel used for the second coating is a normally-pigmented enamel having a plasticized binder. A special feature of our invention consists in the use of a hard quick-baking enamel for the second coating. As a specific illustration of a quick-baking enamel appropriate for use as the second coating in our method, we cite the following:

	Parts by weight
Pigment (deflocculated):	
Dark chrome green	13.0
Binder:	
Urea formaldehyde resin	15.5
Oil-modified alkyd resin	23.5
Solvents:	
Octyl alcohol	15.5
Hi-flash naphtha	27.5
Terpene "B" hydrocarbons	5.0
	100.0

This enamel may be applied in a roll-coating machine, and may be set by baking at a temperature of about 300° F. for about 15 minutes.

The urea formaldehyde resin is a quick-baking resin which is extremely hard after baking. It is placed in the enamel composition in the organic-solvent-soluble state. The resin in this state may be made as follows: 1842 grams 40% formaldehyde and 1.68 grams 85% phosphoric acid are heated in a closed chamber fitted with a stirrer and a condenser to 60° C. 492 grams of urea are added in 8 equal quantities at 5 minute intervals, while maintaining the temperature at 60–65° C. The temperature is then raised to 85–90° C., and held for 2 hours. 1000 grams of n-butanol is then added, and the mass refluxed mildly (90–95° C.) for 2 hours. The reflux condenser is then converted into an ordinary condenser, and water and butanol are distilled off over a period of about 8 hours, and 925 grams of octyl alcohol are added, and distillation is continued until substantially all the butanol is removed and the temperature has reached about 130° C., and the solution is adjusted to 50% non-volatile content with octyl alcohol. It is sometimes necessary to add extra butanol to insure complete dehydration of the resin, before the octyl alcohol is added.

The oil-modified alkyd resin is the same as that used as the binder of the first coating. It is compatible with the urea formaldehyde resin and, being softer than the urea formaldehyde resin, serves to plasticize it.

The pigment is in the fine, deflocculated, fully-wetted condition usual in enamels. The volume ratio of the pigment to binder is about 1:9, which is also usual in enamels.

Enamels having the binder specified in the above formula have been used on preformed metal articles and have been found to provide one of the hardest enamel finishes known. We have discovered the fact, not heretofore suspected, that in spite of the extreme hardness of their binders, these enamel coatings are ductile, are capable when on the metal of stretching as much as 30% without rupture, and are not injured by the surface stretching and surface contraction of steel plates during die-forming operations. We regard the second coating of a quick-baking, plasticized-urea-formaldehyde enamel as an important, although not absolutely essential, feature of our new die-formable blank.

Other normally-pigmented enamels having plasticized binders may be used where the finishing enamel is to be coated before forming. Typical binders which may be used include properly plasticized cellulose derivatives and resins, in particular oil-modified alkyd resins and oleo-resinous varnishes. Where the enamel is applied after forming, any desired enamel may be used.

Our invention is not limited to the specific die-formable blank which has been described as an illustrative embodiment of it. In the specific illustration, we have described a fender blank because the die-forming operations in making a fender are as severe as those required in forming any automobile body part, so that the use of our invention as a die-formable fender blank shows that the invention is useful in making die-formable blanks for any other part. When embodied in a fender blank, our invention provides means for making a better and more durable fender than those made by present methods, since our invention secures an undercoat of uniform thickness. When embodied in blanks for parts of the body proper, our invention achieves great savings in cost, since it eliminates the waste and expense of the sprayings and sandings of the undercoats required in the use of uncoated blanks. These advantages are attained even though the die-formable blank does not have the second coat which has been described, and it is for this reason that we do not regard the finishing coat as an absolute essential of our die-formable blank. This second coat, however, is an important feature of our invention, since it eliminates the waste and labor cost of a spraying operation.

What is claimed is:

1. A die-formable blank for an automobile body part or the like consisting of a flat steel plate having a highly-pigmented, dull enamel undercoating and a normally-pigmented, gloss enamel outer coating, both coatings being ductile.

2. A die-formable blank comprising a flat steel plate of from 16 to 20 gauge, and an adherent, smooth, dull-surfaced enamel coating of a uniform thickness between ¼ mil and 1 mil, having such ductility as to be capable of a 30% stretch without fracture.

3. A die-formable blank consisting of a flat steel plate of from 16 to 20 gauge, an adherent, smooth, dull-surfaced enamel undercoating of a uniform thickness between ¼ mil and 1 mil, and a smooth, gloss-surfaced outer coating adherent to the undercoating, both coatings having such ductility as to be capable of a 30% stretch without fracture.

4. A die-formable blank comprising a flat steel plate and a coating consisting of a flexible, metal-adherent binder incorporating pigment in enamel condition in a quantity sufficient to give a dull surface.

5. A die-formable blank comprising a flat steel plate and a coating consisting of an oleo-resinous binder incorporting pigment in enamel con-

dition in a quantity sufficient to give a dull surface.

6. A die-formable blank comprising a flat steel plate and a coating consisting of an oil-modified alkyd resin incorporating pigment in enamel condition in a quantity sufficient to give a dull surface.

7. A die-formable blank comprising a flat steel plate and a dull coating consisting of a flexible, metal-adherent binder incorporating rust-inhibiting, covering and filling pigment in enamel condition the volume ratio of pigment to binder being between 1:3 and 1:1.

8. A die-formable blank comprising a flat steel plate and a dull coating consisting of an oil-modified alkyd resin incorporating pigment in enamel condition, the volume ratio of pigment to binder being between 1:3 and 1:1.

9. A die-formable blank comprising a flat steel plate and a dull coating consisting of an oil-modified alkyd resin incorporating zinc chromake and Venetian red in enamel condition, the volume ratio of pigment to binder being between 1:3 and 1:1.

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