

UNITED STATES PATENT OFFICE

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METHOD OF PRODUCING METAL ARTICLES
WITH HIGHLY FINISHED SURFACES FOR
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corporation of OhioNo Drawing. Application November 1, 1949,
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13 Claims. (Cl. 113—116)

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This invention relates to a method of producing formed metal articles for receiving highly finished surfaces for coating and to metal articles having thin hard permanent high finish or gloss decorative and protective surface coatings such as surface coatings of bright nickel or chrome plate or of quick drying high gloss lacquers and the like such as customarily used on automobile bodies.

This application is a continuation in part of my co-pending application Serial No. 690,834, filed October 15, 1946, now abandoned.

In the automotive trade, for example, automobile bumpers, head lights, and other parts are bright plated with an extremely thin coating of the plating materials. Automobile bodies and the like are coated with very thin coatings of quick drying paints and enamels which usually include very volatile solvents.

In such instances, particularly in the case of bright plated articles, since the coating is very thin its outer exposed surface conforms in contour to the metal surface on which it is applied and it does not bridge across any scratches or surface irregularities as do thick coatings. Thus any scratches, blemishes or other surface irregularities on the metal surface of the article are readily discernible in the outer surface of the coating. Furthermore, due to the thinness of such coatings, if by chance a coating should bridge across any scratch or surface irregularity, the coating soon breaks through leaving the metal therebeneath exposed. Likewise in the event of soiled or contaminated spots on the surface of the metal on which the coating is placed, the coating does not adhere properly to such spots and the portion of the coating overlying the soiled spots subsequently flakes off because of lack of adherence and because the coating on the metal adjacent thereto is too thin and weak to sustain that overlying the soiled spots. It is apparent therefore that when so coating articles the surface of the metal to which the coating is applied must be very clean, polished, and free from any scratches, blemishes and contamination.

For the purposes of illustration my method will be described as applied to the preparation and production of automobile bumpers having bright plated surfaces, the problems presented thereby and the solutions therefor, as applicable to other articles having bright plated surfaces, and articles having thin high gloss coatings of enamel, lacquer, and the like, being readily apparent from the illustrative example.

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In the production of automobile bumpers having bright plated surfaces, the prior practice has been as follows:

The metal stock from which the bumpers are made is a very tough steel and difficult to draw. This stock as received from the steel mill is first blanked out, then heated and hot drawn to the desired shape and contour after which it is deep pickled for a long period to remove scale and foreign matter. After deep pickling it is rinsed in hot water and cleaned in a strong aqueous alkaline bath which not only cleans the surface but neutralizes any acids carried over from the pickling operation. Next, the surface of the formed piece is rough polished, the larger surface areas thereof which are relatively flat or have a simple curvature of long radius being rough polished by machines and the surface areas of short radius and of compound curvatures and the less accessible areas being polished by hand. In these polishing steps compounds employing mixtures of abrasives and oils, greases or waxes are used. After polishing the surfaces they are hand buffed using conventional grease and wax containing buffing compounds. After buffing, the formed article is cleaned by soaking in a strong alkaline bath, followed by a water rinse. Next the article is electrolytically cleaned, rinsed, given a light acid rinse to make the surface receptive for the plating but not sufficient exposure to disturb the polished finish. It may then be rinsed in water. Following rinsing the surfaces are electroplated with copper, nickel and chrome, successively. Usually, in the first plating bath they are subjected to a reversal of current for an instant in order to condition the surface.

After plating, the plated surfaces are buffed again to the final finish desired.

If the surfaces are to be coated with enamel and the like, the article, after the cleaning effected by soaking in the strong alkaline solution, and rinsing, above described, is dried and then coated.

As an example, assuming a plant to have a capacity of 7,000 bumpers in twenty-four hours using this method, most of the time consumed in actual production is that required for the deep pickling, polishing and buffing steps. A very substantial amount of time also is lost due to "down time" for die touch-up and reconditioning. The percentage of rejects is relatively high.

One of the greatest difficulties encountered in the prior process is that of properly and uniformly polishing and buffing the surfaces of the

formed article, especially those surfaces of short radius or of compound curvature, or those areas in which two or more surfaces intersect to form deep corners or acute angles, or in which ready access to the surfaces is not afforded due to the shape of the formed article.

Furthermore, in polishing and buffing, foreign material, pigments, oils, greases and waxes are rubbed into the finished surface and must be completely removed in order to permit plating of good adherence and uniform appearance. The removal of such foreign materials from the finished article also is difficult.

One of the objects of the present invention is to provide a method of producing formed articles with high gloss surfaces in which the difficulties encountered in the prior process are overcome and, concurrently, a number of the longest and most expensive steps of the prior process are eliminated.

Another object is to produce articles having a better and brighter finish than those produced by the prior method.

A more specific object is to provide a method of producing formed articles with bright plated or high gloss surfaces in which the surface to be coated is polished to the desired high degree of smoothness before the metal stock is formed and while it is flat, in which the polished surface is retained in the highly polished condition and free from scratches and contamination throughout the die forming operations, and in which the prior art step of deep pickling is eliminated.

In accordance with the present method, flat steel strip stock for automobile bumpers, as received from the mill, is dry polished in the flat by machines employing sanding belts and abrasives, without oils and greases, to provide the surface desired, following which the stock is washed in hot water to remove any abrasive grits.

Such a surface is obtained by the use of abrasive grits with a fineness of 200 mesh or more; for example, of 280 mesh.

If in any instance polishing compounds which include oils and greases are used, the polishing can be done quite easily with the stock in the flat, but an expensive cleaning step must follow such practice and polishing without greases, oils, and waxes is much to be preferred.

The flat polished stock is then coated with a completely water-soluble composition which preferably comprises an organic lubricating and protective binder and a major portion of water-liberating and glass-forming inorganic material, and which is free from any abrasive or barrier material. If desired, a small amount of organic hydrophilic colloidal material may be included but such is not necessary.

The stock so coated is then cold blanked in the absence of any other lubricant and, without recoating and in the absence of any other lubricant, is cold formed and drawn in dies to the desired final shape. After drawing, the formed article is cleaned in a mild alkaline bath often followed by water rinse, this being the only cleaning necessary due to the complete water solubility of the coating employed. If desired, this cleaning step may be followed by a short electrolytic cleaning as a precautionary step for the removal of any fingerprints, oils, greases and the like which may be on the surface as an incident of handling the articles but such is not necessary if care is exercised in handling after the water cleaning step. Again, after cleaning,

the article may be dipped in acid, if desired, to open up and superficially etch the surface. This acid dipping step is not to be confused with pickling in acid. The acid dipping step is of very short duration and merely assures cleaning and causes a very slight superficial surface action or etching which conditions the surface for better adherence without essentially changing its condition of smoothness. It is not the usual deep etch which requires an appreciable interval or a pickling step which requires long exposure of the metal to the acid and actually causes dissolution and freeing of scale and the like and very deep pitting of the surface, changing its condition of smoothness materially and rendering it relatively rough. This step is optional, but is preferred. It is usually followed by a water rinse. The article then is plated, its surface being substantially in the polished condition in which it existed at the end of the original polishing operation and free from scratches, blemishes, die marks and the like. In case the article is to be coated with an enamel and the like, the rinsing step following the acid rinse is followed by drying.

The usual steps of buffing, polishing or other steps of finishing the articles following the plating or painting operation are unnecessary. The polishing step above described is preferably a dry polishing step using no coolant whatever. On very thin stock where the temperature of the stock may be raised an undesirable degree by the polishing, water or completely water-soluble materials may be used as a coolant though this generally is unnecessary.

Since the protective and lubricating coating adheres tenaciously to a highly polished surface when dried thereon, it can be used without any danger of failure in providing proper lubrication during the forming operation. Thus the expensive steps of heating and hot forming the stock, deep pickling, hot rinsing in a strong alkaline bath, hand polishing, buffing, cleaning in strong alkaline baths, and rebuffing, are eliminated.

As a comparison with the example heretofore given as to the production obtained with the prior methods, a plant which under the prior method could produce about 7,000 bumpers in twenty-four hours can, using the present method, produce 7,000 bumpers in eight hours. The saving in time in actually processing the stock is about one-third, and additional savings result from the elimination of down time for die retouching and regrinding, the substantial elimination of losses due to rejects, less space requirements, and longer die life. The die life in the present method is practically unlimited as there does not appear to be any die deterioration.

By the use of the present method therefore, the stock is polished to the required high polish in the flat and formed without contamination of the surface and without scratching or marring the polished surface and the polished surface can be plated or otherwise coated in the polished condition in which it exists at the completion of the forming operation. All that is necessary is to wash off the residual lubricating composition.

The composition used in the present method is one composed entirely of water-soluble materials. A dry mix of the ingredients of the composition is dissolved in water in the ratio of about one pound of the dry mix to one gallon of water and is applied to the polished stock by dipping,

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spraying, or otherwise, after which the stock with the coating thereon is dried. The composition thus applied forms on the stock a dry self adherent homogeneous lubricating and protective coating. The proportions of the ingredients of a suitable dry mix composition for use in my method are as follows, the percentage given being by weight:

	Broad	Preferred
A water-soluble organic lubricating and protecting binder.....	Percent 10-33	Percent 20
Water-soluble inorganic glass-forming water-liberating material, such as alkaline earth metal borate.....	80-67	80

One class of materials which may be used as the organic lubricating binders are water-soluble soaps, preferably high titre soaps, having a melting point of at least about 36° centigrade upwardly, specific examples being tallow soap, palm oil soap, stearic acid soap, cocoa butter soap, Borneo tallow soap, hydrogenated tallow soap, coacercic soap, japaic soap, palmitic acid soap, stearin flux soap, multiple pressed tallow soap, hydrogenated palm oil soap, and multiple-pressed palm oil soap.

It should be noted that each of the above soaps may be used individually or in admixture with one or more of the other soaps in any desired proportions, in so long as the amount of soap present is within the broad limits hereinbefore recited.

An additional class of materials are water-soluble aliphatic polyhydric alcohols having less than four hydroxy groups, fatty acid esters thereof or mixtures of either, or both, and with a particular preference for those having a melting point of at least about 40° centigrade, specific examples being polyethylene glycol, polyethylene glycol oleate, glyceryl stearate, propylene glycol stearate, di-glycol stearate, etc.

As hereinbefore indicated, mixtures of compounds in each class are contemplated for use in blending the ultimate composition. Moreover, it should be particularly stated that a mixture of the two aforementioned classes may be employed, such as, for example, a soap and a polyhydric alcohol, soap and an ester of the alcohol, a mixture of soaps and an alcohol or an ester or a mixture of the two. When employing such a mixture the soap should always be in the same or greater amount as the polyhydric alcohol.

The water-soluble alkaline earth metal borates employed in combination with the organic lubricating binder include borax, lithium borate, and potassium borate. Borax is the preferred material due to its ready availability and low cost and also, in certain methods of application, the other borates tend to disburse the organic binder and, if the coated metal stock stands for any considerable period of time, the coating tends to become tacky.

In some instances, it will be found beneficial to combine with the aforesaid composition a minor amount of an organic hydrophilic colloidal material such as, for example, cornstarch, potato starch, wheat starch, etc. Under such circumstances the colloidal material will be present in an amount from between about 1% to 8%, the lubricating binder about 15% to 25%, and the borate about 67% to 84%.

Having described the composition to be employed in my new process it therefore becomes convenient to list a few illustrative examples of

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such compositions, the percentages given being by weight:

Example 1

	Parts
Tallow soap.....	15
Borax.....	85

Example 2

Palm oil soap.....	18
Borax.....	82

Example 3

Tallow soap.....	24
Borax.....	76

Example 4

Tallow soap.....	10
Palm oil soap.....	6
Borax.....	84

Example 5

Palm oil soap.....	20
Borax.....	80

Example 6

Polyethylene glycol.....	15
Borax.....	85

Example 7

Polyethylene glycol.....	22
Borax.....	78

Example 8

Polyethylene glycol.....	20
Polyethylene glycol oleate.....	20
Borax.....	80

Example 9

Polyethylene glycol oleate.....	7
Lithium borate.....	93

Example 10

Polyethylene glycol.....	28
Potassium borate.....	72

Example 11

Glyceryl monostearate.....	12
Polyethylene glycol oleate.....	88
Potassium borate.....	88

Example 12

Propylene glycol stearate.....	30
Lithium borate.....	70

Example 13

Diglycol stearate.....	18
Borax.....	82

Example 14

Propylene glycol stearate.....	20
Diglycol stearate.....	80
Lithium borate.....	80

Example 15

Polyethylene glycol stearate.....	15
Propylene glycol stearate.....	85
Borax.....	85

Example 16

Tallow soap.....	5
Polyethylene glycol.....	10
Borax.....	85

Example 17

Palm oil soap.....	10
Polyethylene glycol.....	12
Borax.....	78

Example 18

	Parts
Tallow soap	10
Palm oil soap	5
Polyethylene glycol	10
Polyethylene glycol oleate	80
Lithium borate	

Example 19

Cocoa butter soap	30	10
Polyethylene glycol oleate	5	
Lithium borate	65	

Example 20

Stearic acid soap	5	15
Polyethylene glycol	30	
Potassium borate	65	

Example 21

Borneo tallow soap	20	20
Glyceryl monostearate		
Polyethylene glycol oleate	5	
Potassium borate		
Borax	75	

Example 22

Hydrogenated tallow soap	7
Propylene glycol stearate	25
Lithium borate	70

Example 23

Coacetic		10
Japanic		
Diglycol stearate		
Propylene glycol stearate	8	
Lithium borate	35	
Borax	82	

Example 24

Palmitic acid soap	15	40
Diglycol stearate	5	
Borax	80	

Example 25

Stearin flux soap	20	45
Borax	80	

Example 26

Hydrogenated tallow soap	35	50
Borax	65	

Example 27

Hydrogenated palm oil soap	10	55
Lithium borate	90	

Example 28

"Triple-pressed" tallow soap		30
Hydrogenated palm oil soap		
Potassium borate	70	

Example 29

Cocoa butter soap	18	60
Potassium borate	82	

Example 30

Stearin flux soap	15	65
Lithium borate	85	

Example 31

Coacetic soap	25	70
Borax	75	

Example 32

Japanic soap	22	75
Potassium borate		
Borax	78	

Example 33

	Parts
Borneo tallow soap	20
Borax	
Lithium borate	80

Example 34

Stearate acid soap	28
Borax	72

Example 35

Stearin flux soap		15
Stearic acid soap		
Borax		
Lithium borate		85

Example 36

Borneo tallow soap		20
"Triple-pressed" palm oil soap		
Borax		80

Example 37

Stearin flux soap	17
Borax	80
Sulphonated castor oil	3

Example 38

Hydrogenated tallow soap	22
Borax	
Lithium borate	73
Liquid glycol	
Sodium lauryl sulphate	5

I claim:

1. The method of producing, by drawing between metal dies, pressure shaped metal articles having highly polished surfaces for receiving a thin permanent high gloss decorative coating comprising: polishing the surface of metal stock, having the metallurgical properties required in the finished article, in the flat with material of which the abrasive consists of grits of at least about 200 mesh fineness to the final highly polished finish required on the final article, cleaning the surface of the stock to remove the polishing material, then coating the polished surface of the stock with a composition of completely water soluble organic lubricating material and water soluble inorganic water liberating metal salt, by applying and drying on the stock an aqueous solution of the composition to form on the stock a thin water soluble self-adherent and tenacious dry lubricating and protective coating free from abrasive and barrier material and which, during the drawing of the stock between the metal dies, is capable of lubricating and maintaining the polished surface, in the absence of the addition of other types of lubricants, in substantially the polished condition in which it existed at the completion of the polishing operation, then cold drawing the coated stock between metal dies, and washing off the residual coating material remaining on the shaped stock, whereby the polished surface of the shaped stock is substantially in the condition of smoothness in which it existed at the completion of the polishing operation.

2. The method of producing, by drawing between metal dies, pressure shaped metal articles having highly polished surfaces for receiving a thin permanent high gloss decorative coating comprising: polishing the surface of metal stock, having the metallurgical properties required in the finished article, in the flat with material of which the abrasive consists of grits of at least

about 200 mesh fineness to the final highly polished finish required on the final article, cleaning the surface of the stock to remove the polishing material, then coating the polished surface of the stock with a composition comprising water soluble organic lubricating material and a larger amount of water soluble inorganic water liberating metal salt by applying and drying on the stock an aqueous solution of the composition to form on the polished surface a thin soluble self-adherent and tenacious dry lubricating and protective coating free from abrasive and barrier material and which, during the drawing of the stock between metal dies, is capable of lubricating and maintaining the polished surface, in the absence of the addition of other types of lubricants, in substantially the polished condition in which it existed at the completion of the polishing operation, then cold drawing the coated stock between metal dies, and washing off the residual coating material remaining on the shaped stock, whereby the polished surface of the shaped stock is substantially in the condition of smoothness in which it existed at the completion of the polishing operation.

3. The method of producing, by drawing between metal dies, pressure shaped metal articles having highly polished surfaces for receiving a thin permanent high gloss decorative coating comprising: polishing the surface of metal stock, having the metallurgical properties required in the finished article, in the flat with material of which the abrasive consists of grits of at least about 200 mesh fineness to the final highly polished finish required on the final article, cleaning the surface of the stock to remove the polishing material, then coating the polished surface of the stock by applying and drying on the stock, to form on the stock a thin soluble self-adherent and tenacious dry lubricating and protective coating, an aqueous solution of a composition comprising, by weight, water-soluble organic lubricating and protecting material about 10-33% and water-soluble, water-liberating inorganic metal salt about 90-67%, then cold drawing the coated stock between metal dies, and washing off the residual coating material remaining on the shaped stock, whereby the polished surface of the shaped stock is substantially in the condition of smoothness in which it existed at the completion of the polishing operation.

4. The method according to claim 2 characterized in that the metal salt is an alkali metal borate.

5. The method according to claim 2 characterized in that the organic lubricating material is water soluble aliphatic polyhydric alcohols having less than four hydroxy groups.

6. The method according to claim 2 character-

ized in that the water soluble organic lubricating material is fatty acid esters of aliphatic polyhydric alcohols having less than four hydroxy groups.

7. The method according to claim 2 characterized in that the water soluble organic lubricating material is a mixture of polyhydric alcohols having less than four hydroxy groups and fatty acid esters thereof.

8. The method according to claim 2 characterized in that the water soluble organic lubricating and protecting material is a soap, and the water soluble inorganic metal salt is an alkali metal borate.

9. The method according to claim 2 characterized in that the polishing step is a dry polishing step.

10. The method according to claim 2 characterized in that, after removal of the residues of the lubricating coating, the article is subjected to an acid dip for a short interval of time and is then rinsed.

11. The method according to claim 2 characterized in that the water soluble organic lubricating material is high titre soap having a melting point of at least about 36° C., and the water soluble salt is borax.

12. The method according to claim 1 characterized in that a very thin high gloss decorative coating is applied to the polished surface of the shaped article.

13. The method according to claim 2 characterized in that a very thin permanent high gloss decorative coating is applied to the polished surface of the shaped article.

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