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BATH FOR BRASS IMMERSION COATING ON
ALUMINUM AND ALUMINUM ALLOY

Alvin R. Balden, Plymouth, and Leland M. Morse,
Pontiac, Mich., assignors to Chrysler Corpora-
tion, Highland Park, Mich., a corporation of
Delaware

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This invention relates to an improved immer-
sion deposition particularly for aluminum and
aluminum alloys.

More specifically, the invention pertains to an
improved brass immersion deposition of this kind.

One of the main objects of the invention is to
provide an immersion bath by which coatings of
brass having improved bearing properties can be
readily formed on aluminum and aluminum alloy
surfaces.

Another object of the invention is to provide a
bath of this character from which coatings of
brass may be deposited on and integrally bonded
to surfaces comprising aluminum and aluminum
alloys.

A further object of the invention is to provide
a brass immersion bath of this kind which is
conveniently controllable to predetermine the
color and character of the deposit formed thereby.

We have found that the presence of critical
amounts of lead salts in brass immersion coating
baths from which brass is deposited by chemical
displacement produces coatings on aluminum and
aluminum alloy surfaces which are extremely ad-
herent to such surfaces and have excellent bear-
ing properties. It has also been found that the
appearance of the resulting coatings can be con-
trolled within ranges of color varying from pink
through yellow, to green, by suitable control of
the lead salt content of the bath. The thickness
characteristics of the resulting deposit can cor-
respondingly be controlled by the lead salt content
of the bath. When the lead salt content is such
as to produce a pink deposit, the coating can be
built upon aluminum and aluminum alloy sur-
faces, to a greater thickness than those of yellow
and green deposits, the yellow deposit being capa-
ble of being built up to a greater thickness than
the green.

A brass coating bath embodying the invention
may be made as follows, the quantities of mate-
rials specified being in amounts sufficient to pro-
duce one gallon of the finished bath. Approxi-
mately 30 ounces of a composition commercially
known as "Wyandotte ZA-30" manufactured by
Wyandotte Chemical Company of Wyandotte,
Michigan, are dissolved in approximately one pint
of water. This composition comprises the re-
action product of substantially 30% zinc oxide
and 54% sodium hydroxide, the reaction product

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being Na_2ZnO_2 in the presence of an excess of
 NaOH . Solution of the foregoing ingredient in
a relatively small amount of water in the order
of 10% to 25% of the volume of the final bath
avoids precipitation of zinc hydroxide from the
solution.

A solution of approximately 3.17 ounces of sodi-
um cyanide in substantially one pint of water
is then prepared and to it is slowly added during
stirring approximately 1.75 ounces of cuprous
cyanide $\text{Cu}_2(\text{CN})_2$. The resulting sodium copper
cyanide ($\text{Na}_2\text{Cu}(\text{CN})_3$) is then mixed with the
above mentioned solution of sodium zincate and
sodium hydroxide ($\text{Na}_2\text{ZnO}_2 + \text{NaOH}$) and suffi-
cient water is added during constant stirring to
make the total solution up to one gallon.

To one-half pint of the last mentioned solution
is added .014 ounces of basic lead carbonate.
Any lead salt which is soluble in caustic solution,
such as lead oxide, lead acetate or lead hydroxide
can be used in its molecular equivalent in place
of basic lead carbonate and combinations of such
soluble lead compounds may also be used. This
lead salt containing solution is then introduced
into the previously formed sodium zincate-sodium
hydroxide and sodium copper cyanide solution to
form the finished immersion bath. The lead salt
is dissolved in the diluted bath solution in order
to avoid reducing its solubility in the concen-
trated solution.

The foregoing bath is particularly compounded
to produce on high alloy content aluminum alloys,
brass immersion coatings of generally yellow col-
oration having desirable bearing properties. In
this bath, a coating of approximately .0001 inch to
.00015 inch thickness is produced on such alumi-
num alloys by an immersion time of about five
minutes. A coating formed by this bath has been
found to be particularly suitable for pistons hav-
ing the following composition: copper 6.25% to
7.75%, silicon 5% to 6%, magnesium .15% to
.40%, iron 1.5% maximum, impurities including
zinc .75% maximum, and the remainder alu-
minum.

The above bath is thus compounded from in-
gredients comprising 15.8 oz. per gallon sodium
zincate, 16.2 oz. per gallon of sodium hydroxide,
1.75 oz. per gallon of copper cyanide, 3.17 oz. per
gallon of sodium cyanide and .014 oz. per gallon of
basic lead carbonate. For coating alloys of the

above specified type the formula may vary as follows:

Example I

Sodium zincate—from 13 oz. to 16 oz. per gallon
Sodium hydroxide—from 13 oz. to 20 oz. per gallon

Copper cyanide—from 1.5 oz. to 2 oz. per gallon
Sodium cyanide—from 2.75 oz. to 3.5 oz. per gallon

Basic lead carbonate or equivalent—from .01 oz. to .03 oz. per gallon.

Variation of the lead content of the above described bath composition has the following effect upon color and thickness characteristics. When the lead metal content is between .003 oz. per gallon and .016 oz. per gallon, the deposit is yellow in color and has a maximum thickness of .00015 inch which will be formed in an immersion time of about five minutes at about 115° F. When the lead metal content is above .016 oz. per gallon, the deposit is green in color and has a maximum thickness of .0001 inch which will be formed in an immersion time of about five minutes at 115° F. With a lead content below .003 oz. per gallon the deposit tends to be pink and attains a thickness of about .0002 inch in approximately five minutes at 115° F. This latter deposit does not as strongly adhere to the aluminum alloys as the above mentioned yellow and green deposits. While the pinkish deposit may be useful for ornamental purposes, its lack of bond reduces its value for mechanical purposes such as piston and bearing surfaces. The upper limit of the lead salt content is established by the lead salt concentration at which pure lead is deposited in a powdery form upon the brass deposit. When coating aluminum alloy of the foregoing composition with the bath described for that purpose, the upper limit of lead salt content is about .03 oz. per gallon. The upper limit of the lead salt content increases with increased aluminum content of aluminum alloy being coated. When immersion coating pure aluminum, the lead salt content may be as high as .1 oz. per gallon but this value should not be substantially exceeded.

While the foregoing bath composition has been found to be preferable in forming brass immersion coatings on pistons of the above composition, it has also been determined that exceptionally satisfactory results are obtainable in forming brass coatings for various purposes on diverse aluminum alloys, with baths having the following range of compositions:

Sodium zincate—8 oz. to 45 oz. per gallon
Sodium hydroxide—25 oz. to 125 oz. per gallon
Copper cyanide—.1 oz. to 6 oz. per gallon
Sodium cyanide—.1 oz. to 12 oz. per gallon
Basic lead carbonate—.003 oz. to .1 oz. per gallon

Immersion coatings formed on aluminum alloy of the type previously recited by a bath within the range of composition specified in Example I:

	Per cent
Copper -----	35 to 40
Lead -----	.1 to 2
Zinc -----	Remainder

While the precise chemical operation performed by the lead content of the bath is not known with certainty, it has however been established that the lead content of the solution controls the rate of deposit and accordingly the quality of the deposit and its bond. It has also been determined that it is preferable to increase the lead content

of the solution as the purity of aluminum in the alloy being coated increases. Likewise, as the aluminum content of the alloy increases the sodium zincate and sodium hydroxide content of the bath should also be increased in order to obtain optimum results.

Quantities of lead salts referred to herein are inclusive of lead salt impurities and such impurities should be taken account of in compounding the solution.

Articles to be coated by immersion are preferably cleaned in one of two ways. In the coating of mechanical parts in which adhesion is more important than appearance, an etching type cleaner is preferably employed, such as an aqueous sodium hydroxide solution. Where it is desired to retain the bright finish of a part, a non-etching type cleaner containing sodium carbonate and sodium silicate, for example, is employed.

When an etching type cleaner is used on aluminum containing copper and/or silicon, the cleaning operation should be followed by treatment in an acid dip containing nitric and hydrofluoric acids in order to remove the resulting smut. After the brass immersion deposition has been formed, the coated part is momentarily immersed in a dilute nitric acid solution, about one-half of one per cent by volume, and then washed in water. The dilute nitric acid treatment preserves the color of the immersion deposition.

Although but several specific embodiments of the invention are herein described, it will be understood that various changes in the sequence of operations, steps and materials employed may be made without departing from the spirit of the invention.

We claim:

1. A bath for depositing a brass coating by chemical displacement comprising from approximately 8 oz. to 45 oz. per gallon sodium zincate, from approximately 25 oz. to 125 oz. per gallon of sodium hydroxide, from approximately .1 oz. to 6 oz. per gallon of copper cyanide, from approximately .1 oz. to 12 oz. per gallon of sodium cyanide, from approximately .003 oz. to .1 oz. per gallon of basic lead carbonate, and the remainder water.

2. A bath for depositing a brass coating by chemical displacement on aluminum alloy of the class which includes of the order of 6.25% to 7.75% copper, 5% to 6% silicon, .15% to .40% magnesium, up to 1.5% iron, up to .75% impurities including zinc and the remainder aluminum; comprising approximately 15.8 oz. per gallon of sodium zincate, 16.2 oz. per gallon of sodium hydroxide, 1.75 oz. per gallon of copper cyanide, 3.17 oz. per gallon of sodium cyanide and an amount of lead salt soluble in caustic solution and equivalent to .014 oz. per gallon of basic lead carbonate.

3. A bath for depositing a brass coating by chemical displacement on aluminum alloy of the class which includes of the order of 6.25% to 7.75% copper, 5% to 6% silicon, .15% to .40% magnesium, up to 1.5% iron, up to .75% impurities including zinc and the remainder aluminum; comprising approximately from 13 oz. to 16 oz. per gallon of sodium zincate, from 13 oz. to 20 oz. per gallon of sodium hydroxide, from 1.5 oz. to 2 oz. per gallon of copper cyanide, from 2.75 oz. to 3.5 oz. per gallon of sodium cyanide and an amount of a lead salt soluble in caustic solution equivalent to .01 oz. to .03 oz. of basic lead carbonate.

4. The method of making a bath for depositing

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a brass coating by chemical displacement on aluminum and aluminum alloys which consists of dissolving sodium zincate and sodium hydroxide in an amount of water corresponding to 10% to 25% of the final volume of the bath, dissolving sodium cyanide in a separate container in a substantially equal amount of water, dissolving copper cyanide in said sodium cyanide solution, mixing said foregoing solutions, adding water to make up bath volume, and dissolving in the resulting solution a lead salt soluble in caustic solutions.

5. A bath for depositing a pink colored brass coating by chemical displacement on an aluminum alloy comprising approximately 15.8 oz. per gallon of sodium zincate, 16.2 oz. per gallon of sodium hydroxide, 1.75 oz. per gallon of copper cyanide, 3.17 oz. per gallon of sodium cyanide and an amount of lead salt soluble in caustic solution equivalent to not more than .003 oz. per gallon of basic lead carbonate.

6. A bath for depositing a yellow colored brass coating by chemical displacement on an aluminum alloy comprising approximately 15.8 oz. per gallon of sodium zincate, 16.2 oz. per gallon of sodium hydroxide, 1.75 oz. per gallon of copper cyanide, 3.17 oz. per gallon of sodium cyanide and an amount of lead salt soluble in caustic solution equivalent to .003 oz. to .016 oz. per gallon of basic lead carbonate.

7. A bath for depositing a green colored brass coating by chemical displacement on an aluminum alloy comprising approximately 15.8 oz. per

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gallon of sodium zincate, 16.2 oz. per gallon of sodium hydroxide, 1.75 oz. per gallon of copper cyanide, 3.17 oz. per gallon of sodium cyanide and an amount of lead salt soluble in caustic solution equivalent to .016 oz. to .03 oz. per gallon of basic lead carbonate.

8. The method of brass coating aluminum and aluminum alloy which comprises depositing brass thereon by chemical displacement in a bath comprising from approximately 8 oz. to 45 oz. per gallon sodium zincate, from approximately 25 oz. to 125 oz. per gallon of sodium hydroxide, from approximately .1 oz. to 6 oz. per gallon of copper cyanide, from approximately .1 oz. to 12 oz. per gallon of sodium cyanide, from approximately .003 oz. to .1 oz. per gallon of basic lead carbonate, and the remainder water.

ALVIN R. BALDEN.

LELAND M. MORSE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,947,981	Fischer	Feb. 20, 1934
2,086,841	Bagley	July 13, 1937
2,230,602	Sullivan	Feb. 4, 1941

OTHER REFERENCES

Meyer et al., The Electrochemical Soc. Preprint, pp. 299, 300, 312, 314, 320, 321 (1938).