

UNITED STATES PATENT OFFICE

LEON R. WESTBROOK, OF CLEVELAND HEIGHTS, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE GRASSELLI CHEMICAL COMPANY, OF CLEVELAND, OHIO, A CORPORATION OF DELAWARE

CHROMIUM PLATING

No Drawing.

Application filed February 23, 1928. Serial No. 256,494.

The only commercially successful chromium plating is up to the present time obtained from a chromic acid bath containing a small amount of a compound capable of dissociating to yield an anion, such as the sulfate SO_4^{--} ion. The current efficiency in such a bath is relatively low, usually from 12% to 15%, and the conditions during plating have to be kept within a narrow range of temperature and current density if hard, bright, and adherent plates are desired. The common expedient of adding a more or less colloidal organic substance to the plating bath both as used in the plating of other metals, is inoperative in the case of chromium; the strongly oxidizing chromic acid bath would destroy most of the available organic materials.

My invention consists now of a chromic acid electroplating bath containing certain inorganic addition agents.

The agents which I have found beneficial in a chromic acid bath containing small amounts of an anion are compounds of the metals contained in the group comprising molybdenum and vanadium. While these two metals are not generally considered to be closely related or to have very similar chemical properties, they have been found to act quite alike and different from any other heavy metal compound tested by me when one of their compounds is contained in a chromic acid plating bath. While most any molybdenum and vanadium compound, soluble in the plating bath, will show a beneficial effect in the chromium plating bath, I prefer to use a bath containing the negative radical corresponding to the higher, acid-forming oxides of these two metals. The most convenient manner of preparing such a bath is to add a water soluble molybdate or vanadate to the chromic acid solution, or to dissolve MoO_3 or V_2O_5 in aqueous caustic alkali and add such a solution to the bath. These oxides, themselves, or other lower oxides can also be added to produce my novel bath. It is suggested that the lower oxides will be quickly transformed in the bath into the higher acid-forming oxides, but I have been unable to prove this, and it is merely offered as a

possible explanation of the similar action of the various soluble molybdenum and vanadium compounds when added to a chromic acid bath.

The molybdate and vanadate radicals do not replace the anion required in the bath for a successful chromium plating. The presence of an anion for instance, SO_4^{--} , is still needed to produce bright plates. Further additions to my novel baths, such as chromium chromate, are not indicated and do not seem to produce any effect on the plating process.

The following are two typical formulæ of novel plating baths embodying my invention:

	Grams per liter	
1. Molybdate bath—		
CrO_3 -----	250	
Na_2SO_4 -----	3	70
MoO_3 -----	3	
NaOH -----	2	
2. Vanadate bath—		
CrO_3 -----	250	
Na_2SO_4 -----	3	75
V_2O_5 -----	3	
NaOH -----	4	

The molybdenum and vanadium compounds were dissolved separately with the caustic soda in a little water and added to the chromic acid, sodium sulfate solutions. The anion, SO_4^{--} , therein is furnished by the sodium sulfate.

The following table gives the conditions under which commercially valuable, bright, hard, adherent chromium plates have been obtained with the above baths. It shows the cathode metal current efficiency in per cent at various temperatures and cathode current densities in amperes per square foot. For purpose of comparison a similar, plain bath, from which the addition agent has been omitted, is included—

Current density-----	100	150	200	
Temperature in °F-----	105-110	110	115	95
Molybdate bath-----	15.5%	15.5%	15%	
Vanadate bath-----	16	16	18	
Plain bath-----	12.5	14.5	17	

The plates obtained in the vanadate and molybdate baths have a somewhat improved appearance, such as better brightness, hard-

ness, and adherence, than those from the plain bath. These figures show, however, an additional advantage in the baths containing the addition agent; the current efficiency is less dependent on the current density which indicates an improved throwing power over the plain bath.

I claim:

1. A chromium plating bath consisting of an aqueous solution of chromic acid containing a small amount of a compound capable of dissociating to yield an anion, and a small amount of a compound of a metal of the group comprising molybdenum and vanadium.

2. A chromium plating bath consisting of an aqueous solution of chromic acid containing a small amount of SO_4^{--} radical and a small amount of the negative radical corresponding to the higher acid-forming oxides of one of the metals of the group comprising molybdenum and vanadium.

3. A chromium plating bath consisting of an aqueous solution of chromic acid containing a small amount of SO_4^{--} radical and a small amount of the negative radical corresponding to one of the acids of the group comprising molybdic and vanadic acid.

In testimony whereof, I affix my signature.

LEON R. WESTBROOK.