

[54] **PROCESSES AND BATHS FOR
ELECTRO-STRIPPING PLATED METAL
DEPOSITS FROM ARTICLES**

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[57] **ABSTRACT**

An electrolytic stripping bath and process that are ideally suited for stripping a large number of different types of plated metal deposits, singularly, in selective combinations, or in the form of selective alloys thereof, from a base metal, such as titanium, forming an article. The bath does not attack or otherwise adversely affect the exposed surface of the base metal, and with the bath being operated at ambient temperature, evaporation of the bath constituents and the generation of fumes during an electrochemical stripping operation are minimized.

8 Claims, No Drawings

PROCESSES AND BATHS FOR ELECTRO-STRIPPING PLATED METAL DEPOSITS FROM ARTICLES

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to the electro-stripping of metals and, more particularly, to electrolytic baths and processes for the electro-stripping of one or more plated metals from a base metal.

2. Description of the Prior Art

The electrolytic removal or stripping of electro-deposited or otherwise plated metals from the base metal of scrapped, rejected or worn articles has become an increasingly important operation in recent years. The removal of such plated metals in order to recover the base metal articles for re-plating is important not only because of the scarcity and/or costs of many raw material base metals, but because of the costs involved in fabricating plated articles. The continuously increasing uses and applications made of plated articles obviously has further added to the urgency of being able to reliably and efficiently salvage many of such articles in their bare metal form for re-use through a re-plating operation. It, of course, in many cases may also prove to be a considerable cost savings to recover even the typically small quantities of electro-stripped plated metal, or metals, in addition to the base metal, for re-use. This is particularly true with respect to rather expensive plated metals, such as gold or silver, or alloy formulations thereof.

Accordingly, various electrolytic baths or solutions and processes have been developed heretofore for stripping electro-deposited metal layers from articles. Such stripping solutions and processes, however, have not proven to be a panacea for all applications, and particularly in high volume assembly line operations where effective and efficient electro-stripping of plated metals in a single operation are required, while leaving the base metal surfaces clean and in satisfactory condition for re-plating. The problems encountered in electro-stripping are compounded, of course, in those situations where there may be two or more dissimilar metals, or one metal and one non-conductive material, such as plastic, covering portions of the outer surface of a given article, and where only selected ones of a plurality of exposed plated metals, or only the exposed plated metal, or metals, as distinguished from any non-conductive exposed material, is to be electro-stripped from the article.

Certain types of plating racks constitute one particular kind of article which at least periodically has conductive as well as permanent non-conductive coatings formed on selective exposed surfaces thereof, and which conductive coatings have presented problems heretofore with respect to the electro-stripping thereof from the racks without producing any deleterious effects. More specifically, one common type of plating rack extensively employed heretofore has consisted of a frame made of copper, a plurality of plating hooks secured thereto made of titanium, for example, and both being covered with a protective insulating coating such as of PVC plastic, with the exception of the tip ends of the plating hooks. These tip ends necessarily have the insulation removed therefrom so as to provide electri-

cal continuity between the plating rack and the articles to be plated.

It becomes readily apparent that as a result of the periodic exposure of such plating racks to any given plating solution, the exposed bare metal tip ends of the plating hooks will progressively acquire a build-up of the same plating material that is deposited on the articles carried thereby. It also is obvious that any electrolytic solutions employed for the purpose of electro-stripping must be of a type that would attack only the plated deposits, and in no way attack or otherwise adversely affect either the plastic insulation or the exposed base metal of the plating racks. While the invention is described herein with particular reference to the stripping of various electro-deposited metals from articles having titanium as the ultimately exposed base metal, it should be appreciated that the present electro-stripping baths may be used in stripping various metals initially deposited in any one of a number of ways from the surfaces of articles composed of tantalum, as well as similar type base metals.

In one particular electro-stripping application, copper-nickel-chromium deposits must be stripped from the tips of the plating rack hooks (without adversely affecting the adjacent protective plastic coating) in a quick and reliable manner, and on a continuously recurring basis. One reasonably effective electrolytic bath often employed for this purpose heretofore has been nitric acid.

Disadvantageously, however, the stripping of electro-deposited metals in a nitric acid bath is an exothermic reaction which, of course, results in the generation of considerable nitrogen oxide fumes. As a result, the bath must necessarily be frequently rejuvenated by additions of nitric acid, lost mainly through evaporation.

Generated nitrogen oxide fumes also present a very serious health hazard that, at least at present, cannot be satisfactorily minimized without considerable expense being incurred. More particularly, because of the relatively low solubility in water of nitrogen oxide fumes, they initially prove to be only slightly irritating to the mucous membranes of the upper respiratory tract. Their warning power, in the sense of limited physical sensitivity is, therefore, low and dangerous amounts of the fumes may be breathed before a worker in the area, for example, notices any real discomfort. Shortly after such exposure, however, very serious temporary and/or permanent physical impairment may be experienced by the individual, particularly with respect to the respiratory system.

As for the use of fume scrubbers, those designed to remove nitrogen oxide fumes are very expensive and complex, and far less efficient than those designed and available for use in removing the fumes generated with certain other types of electrolytic stripping baths.

There have also been a number of other electrolytic baths suggested or employed heretofore in an attempt to effectively and reliably strip plated metals of the type described hereinabove from a base metal, such as titanium, in one operation. One of such other types of stripping baths has been composed of a mixture of sulfuric and nitric acids. This bath, however, has been found to readily attack many types of base metals, including titanium. Thus, before all of the plated metal can be stripped, some of the base metal becomes seriously etched and pitted, requiring extensive polishing operations in many cases and, in certain instances, ren-

dering the base-metal-formed article unacceptable for further use.

Various organic acids have also been suggested and/or tried as electrolytic stripping baths. Unfortunately, such electrolytes do not strip most plated metals in one operation. Accordingly, whenever it has been required to remove two or more different common electro-deposited metals from base metal articles with organic acid electrolytes, this has generally necessitated the maintenance of a plurality of different stripping baths, each formulated to remove a specific metal, or limited combinations of plated metals.

Hydrochloric acid has also been employed heretofore as a metal stripping electrolyte; however, it cannot be used with articles having a titanium base because it readily attacks such a base metal.

Still another electrolytic stripping bath employed heretofore for the removal of plated metal deposits, such as copper, nickel and chromium, either selectively or collectively, has been composed essentially of an aqueous solution of phosphoric acid. The primary disadvantage of this electrolytic stripping bath is the rather slow rate of electro-stripping of chromium and nickel at ambient temperature, even though it has been found to be quite effective at this temperature with respect to the stripping of plated copper. At higher temperatures, and preferably when heated to its boiling point, a phosphoric acid bath may effect fairly rapid electro-stripping of the metals in question, but with considerable problems being encountered in removing the hazardous acidic fumes generated in the process. Another disadvantage of a phosphoric acid bath is that metal cations are normally required, in the form of salt compounds, which necessarily increase the amount of sludge produced.

Aqueous solutions of sulfuric acid either singly or in selective combinations with other acids and/or salts have also been suggested or employed heretofore for use as electro-stripping electrolytes. It has been found, however, that such baths are not very effective and efficient in removing most plated metals of the type described hereinabove. In addition, as sulfuric acid is also most effective when used at elevated temperatures, it likewise evolves considerable quantities of very hazardous fumes that necessitate the need for rather expensive fume scrubbers.

Other electrolytic baths tried heretofore, particularly with respect to removing copper-nickel-chromium deposits from titanium, have been composed, for example, of caustic soda with either potassium cyanide or hydrogen peroxide, as well as of hydrofluoric acid and fluoboric acid individually. Selective combinations of fluoboric acid, chromic acid, sulfuric acid and sodium hydroxide have also been tried heretofore for the application in question. None of these last mentioned bath formulations proved satisfactory in effectively and efficiently stripping metal deposits of the type in question from articles with no attacking of the base metal.

In view of the foregoing, it is readily seen that there has been an urgent need for an inexpensive electrolytic stripping bath that is capable of effectively and efficiently removing from the surface of an article one or more of a large number of various common deposited metals or selective alloy formulations thereof, in one single operation, while leaving a base metal, such as titanium or tantalum, and any other exposed, non-conductive material not to be stripped, clean and un-

blemished. There is also a need in industry for an electro-stripping bath that minimizes problems with respect to the waste disposal thereof, and that generates a minimum of hazardous fumes, if any, of either a noxious or toxic nature that need to be removed, and if removed, accomplished effectively and efficiently with minimal expense. This requirement has become of paramount importance recently as a result of the ever increasing demands imposed on the industry at large concerning ecology, and particularly with respect to air and water pollution.

SUMMARY OF THE INVENTION

It, therefore, is an object of the present invention to provide inexpensive, effective and efficient electrolytic compositions and processes for electro-stripping one or more of a plurality of deposited metals from any one of a plurality of different base metals in one simple operation, and in a manner that leaves the base metal unattacked, and generates a minimum of fumes of a type that in many applications may not even require removal from the atmosphere.

It is another object of the present invention to utilize an unheated electrolytic bath to electro-strip effectively and rapidly, and in one operation, one or more plated metals, deposited either as selective single or multiple layers, or as selective composite alloy layers, from an article having at least one exposed surface area composed of a different base-metal, and the remaining surface area protected with a non-conductive coating, and wherein the bath does not attack either the base metal or the non-conductive coating.

In accordance with the principles of the present invention, the electrolytic stripping bath compositions consist of aqueous solutions of fluoboric acid (HBF_4), phosphoric acid (H_3PO_4) and water in selected predetermined percentage ranges, by weight, or volume, relative to initial acid concentrations. Advantageously, the constituents are relatively inexpensive, readily available, and do not require any extraordinary care in terms of routine handling.

The present electrolytic baths have been found to be particularly effective in the stripping of copper-nickel-chromium build-ups from articles, such as plating racks, which have at least the exposed surface areas thereof formed of titanium. Advantageously, as the bath does not attack either the base metal, when of titanium or tantalum, for example, or most types of plastic, such as PVC, the time during which the plating rack is immersed as an anode in the bath is not critical, with the exposed base metal advantageously remaining clean and unblemished for re-use and/or re-plating.

Electrolytic bath compositions of the type embodied herein are also very effective at room or ambient temperature, which greatly minimizes both evaporation of the constituents and the generations of fumes during electro-stripping. Concomitantly, with respect to the fumes that are generated, they are of a type that may readily and substantially completely be removed from the atmosphere, if required, by conventional fume scrubbers.

DETAILED DESCRIPTION

Referring now in greater detail to the electrolytic stripping baths embodying the principles of the present invention, preferred compositions thereof consist of the following constituents, which may vary within the

following percentage ranges, by weight, and still normally provide satisfactory electro-stripping results: 20-40 percent fluoboric acid (HBF_4), 5-25 percent phosphoric acid (H_3PO_4), and the remainder mainly of water. These percentages are based on a commercial grade of fluoboric acid having a 48 percent concentration, by weight, and on a commercial grade of phosphoric acid having a 75 percent concentration, by weight.

Such unique baths, formulated within the specified constituent percentages, are particularly effective in stripping copper-nickel-chromium deposits from the exposed tip areas of plating rack hooks made of titanium. Such plating racks typically have the frame portions thereof made of copper, for example. A protective coating, such as PVC (one form of which is known as plastisol), substantially covers the entire plating rack, frame and hooks, except in those small exposed tip regions of the hooks where the base metal is exposed so as to provide electrical contact during an electro-stripping operation.

Such racks are employed in one particular application to carry a plurality of die cast telephone handset switch hooks made, for example, of zinc, through a series of three electrolytic plating baths which successively produce a three-layer build-up of copper, nickel and chromium on the switch hooks. Naturally, during the plating operation, the exposed ends of the plating hook tips likewise acquire a successive three-layer build-up of the three aforementioned metals.

In carrying out the processes of the present invention, and with specific reference being made to the electro-stripping of plating racks, each rack with plated build-ups of copper, nickel and chromium on the initially exposed tip regions of the plating hooks thereof is immersed and electrically biased as the anode in the above-described electrolytic bath. The container holding the electrolyte may be any one of a number of conventional types presently available commercially and made, for example, of rubber, or PVC-lined steel tanks. The direct current source connected to each anodic plating rack, and to one or more cathodes, preferably of graphite, may comprise any suitable direct current source, such as a battery, a rectifier or a generator. During electro-stripping, the composite electro-deposited metal layers gradually disintegrate into free metal granules, metallic ions and complexes within the bath until the previously plated base metal areas are completely exposed.

It is obviously apparent that two or more plating racks (or articles) may be electro-stripped simultaneously in a common electrolytic bath, with all functioning as a common anode or each functioning as a separate anode. While it has been found that a graphite cathode (or cathodes) are preferable for use in the electrolytic baths of the present invention, cathodes composed of any other suitable inert conductive material may also be employed. Such cathodes may be formed in any one of a number of conventional shapes, such as in rod or sheet form.

As previously mentioned, it is generally desired that the cathode(s) be dimensioned so as to have an active surface area greater than the total active plated anode area, with the dimensions of the latter being chosen in conjunction with the operating current so as to produce a stripping current density preferably in the range of 10-30 amperes per square inch, with an operating volt-

age of 5-10 volts D.C. The distance between the anode(s) and cathode(s), of course, can also have a direct effect on the time necessary to electro-strip a given plated metal deposit. However, this spacing parameter is functionally the same as increasing or decreasing the current density. In actual practice, a distance of 4 to 8 inches between an associated anode and cathode is generally preferred.

As with most electro-stripping baths, the rate of stripping normally increases directly with current, with the maximum amperage allowed depending primarily on such factors as the size and spacing of the electrodes, the current carrying capacity of the buss bars and associated connections, and the volume of the electrolytic bath. Typically, operating anode stripping current densities in the range of 1,000 to 10,000 amperes per square foot are employed.

The invention is now disclosed in further detail by means of the following examples which are provided for purposes of illustration only. It will be readily apparent to those skilled in the art that modifications in the quantities of materials and operating conditions and the use of equivalent materials can be made without departing from the invention as disclosed herein.

EXAMPLE I

For one particular application relating to the electro-stripping of a three-layer build-up of copper, nickel and chromium from plating rack hooks having a base metal of titanium, one preferred electrolytic bath composition consists, by weight, of:

29.1 percent fluoboric acid (HBF_4)
12.9 percent phosphoric acid (H_3PO_4)
58 percent water

The above preferred electrolytic stripping bath, by weight, is equivalent to the following relative constituent proportions, by volume:

4 parts fluoboric acid (48% acid concentration, 39.9° BAUME')
1 part phosphoric acid (75% acid concentration, 53.2° BAUME')
2 parts water

This specific bath formulation was found to be particularly effective in electro-stripping a plating rack having a plurality of hooks with exposed anodic tip regions thereon equal to six square inches, in total, with a three-layer build-up on each exposed tip of copper (0.0010 inch), nickel (0.0010 inch) and chromium (0.0002 inch), equal to a cumulative thickness of 0.0022 inch. With a spacing of approximately six inches between the plated anodic tips and a cathode (of considerably larger surface area), the bath maintained at ambient temperature, an operating voltage of 7.5 volts D.C., and a constant current of 100 amperes (establishing a plating current density of 16.7 amperes per square inch), a series of six operating runs stripped the three-layer plated deposits from the anodic tips in an averaged time of 40 seconds. The stripped material was equivalent to approximately 0.0132 cubic inches of plated metal by volume, or about 1.01 grams by weight.

It is thus seen that in accordance with the principles of the present invention, electro-deposited metals such as copper, nickel and chromium, singly or in selective combinations may be rapidly and completely removed in one operation from the base metal of an article comprised, for example, of titanium. As the electrolytic

bath does not attack such a base metal, as long as current is applied to the electrodes, the stripped article or articles may be left in the bath over extended periods of time, which may encompass a number of hours, for example, without any deleterious effect on the base metal or any plastic coating thereon, such as PVC. As a matter of fact, the exposed titanium has been found to form a thin titanium oxide layer thereon while briefly exposed to the bath. This oxide layer advantageously retards the time at which etching of the exposed titanium would occur if the current for some reason were cut off before the plating rack was removed from the bath. This latter critical period of time, i.e., with no operating current, normally ranges between zero and two minutes, depending on the makeup of the bath. The same type of oxide layer is advantageously formed on tantalum when exposed to the bath.

Another very important advantage of any present electrolytic bath formulation is that it is capable of electro-stripping a large number of plated metals, thus obviating the need of a separate bath for each different deposited metal. More specifically, not only copper, nickel and chromium may be stripped with an electrolytic bath of the present invention, but also other metals such as brass, tin, zinc, gold and silver. These metals may be employed singly or in selective combinations to form single or multiple layer build-ups, or used as alloys for such purposes. An example of multiple layer build-ups purposefully formed would be in making decorative patterns on articles and may comprise: silver on copper, silver on nickel, gold on copper, gold on nickel, and the like. Examples of combinations of these metals that are used as electro-deposited alloys on a base metal may comprise: silver-copper, gold-silver, gold-nickel, gold-copper, iron-nickel, copper-nickel, iron-nickel-chromium, and the like.

EXAMPLE II

With the same stripping bath composition, plating rack and cathode described in Example I, three operating runs were made, each with a different initially adjusted operating current which was thereafter not maintained constant, but rather, allowed to decrease as the circuit resistance increased. These three runs produced the following results:

PLATING CURRENT	STRIPPING RESULTS
50 amperes (initially)	7 1/2 minutes
100 amperes (initially)	2 minutes
200 amperes (initially)	1 minute

In the above operating electro-stripping runs, the current gradually decreased to zero amperes, due primarily to the aforementioned thin titanium oxide layer that developed on the stripped and exposed titanium surface areas. This oxide layer, as previously mentioned, actually produces a salutary effect in that it acts as a protective coating which extends the period (typically up to several minutes) before the base metal would be attacked by the bath in situations where the current for some reason would be cut off while the plating racks were still immersed in the bath.

EXAMPLE III

Different anode-cathode spacings were also tried, ranging from 1" to 11", with the results obtained indicating that the particular spacing chosen is not very critical. More specifically, using the same stripping

bath, cathode, plating rack and plated layers on the latter as described in Example I, but with only an initial operating current of 100 amperes at 7.5 volts D.C., the following electro-stripping times resulted for the respectively associated cathode spacings:

ANODE-CATHODE SPACING	STRIPPING TIME
1 inch	2 minutes 25 seconds (average 2 runs)
6 inch	2 minutes (average 2 runs)
11 inch	2 minutes 12.5 seconds (average 2 runs)

EXAMPLE IV

As previously pointed out, it has been found that the electrolytic bath constituents may vary, by weight, between the following percentage ranges and still produce satisfactory electro-stripping of the aforementioned plating metals in most applications: fluoboric acid 20-40 percent, phosphoric acid 5-25 percent, with the remainder water. The effectiveness of different electro-stripping baths, all formulated with different selective percentage combinations of the above-identified constituents, by weight, but within the above specified ranges, may be readily seen by the data set forth in the following table. This data was derived using a plating rack and cathode of the same type, spaced and biased in the same manner, and having the same three-layer plated build-up (of 0.0010 in. Cu, 0.0010 in. Ni, 0.0002 in. Cr) on the anodic titanium rack hook tips as described in Example I. As such, during all stripping runs the operating currents and anodic stripping current densities were maintained constant, and the baths were used at ambient temperature.

% HBF ₄	% H ₃ PO ₄	T ₁ (sec)	T ₂ (sec)	T ₃ (sec)
20	5	150.8	55.1	29.4
20	13	138.9	51.0	23.8
20	20	143.5	54.5	25.7
30	5	88.4	45.0	27.9
30	13	75.9	37.2	23.4
30	20	112.7	63.6	37.3
40	5	91.8	56.2	35.6
40	13	197.4	105.3	58.6

T₁=Stripping time corresponding to an anodic current density of 1200 amps/sq. ft. (equivalent to 50 amperes for the particular plating rack employed)

T₂=Stripping time corresponding to an anodic current density of 2400 amps/sq. ft. (equivalent to 100 amperes for the particular plating rack employed)

T₃=Stripping time corresponding to an anodic current density of 4800 amps/sq. ft. (equivalent to 200 amperes for the particular plating rack employed)

From the electro-stripping data set forth in the above table, it is readily seen that the best results were obtained with an electrolytic bath consisting of an aqueous solution, by weight, of 30 percent fluoboric acid, 13 percent phosphoric acid, with the remainder water.

In carrying out the processes of the present invention it, of course, is appreciated that periodic additions of the electrolyte constituents must be added as a result of not only the electro-chemical reaction generation of fumes, and a small degree of attendant evaporation of the constituents, but also because of a small amount of dragout that occurs in an electro-stripping operation.

While the utilization of fluoboric acid in combination with phosphoric acid has been found to be the most advantageous acids, in combination, variations of fluoboric acid in the form of zinc and nickel fluoborates could also possibly be used in place of fluoboric acid in cer-

tain applications. One basic disadvantage with respect to fluoborates, however, is that they substantially increase the metal ion concentrations in the solution which, in turn, have a direct bearing on the degree of sludge that accumulates, and on the effectiveness of the electrolyte in stripping plated metal deposits within a given period of time.

It, of course, is appreciated that as the metal deposits stripped from a given article are dissolved in the electrolytic bath, sludge is necessarily formed and settles to the bottom of the container. In the present baths, such sludge normally doesn't cake or become hard and so is easily removed from the container. Any metal deposits on the cathode(s) may be effectively removed periodically by a mechanical abrasion operation.

As a result of the fact that the present electrolytic stripping bath requires a much lower metal ion concentration (and therefore a slower accumulation of sludge) than is generally the case with previous electrolytic baths, it has been found possible in one plating rack stripping operation to utilize the same bath periodically to strip, for example, up to approximately four pounds of copper-nickel-chromium deposits, per gallon of solution, over a period of at least several months before both the amount of sludge and the ion concentration increase to such an extent that it is more advantageous to dispose of the bath than filter out the sludge and rejuvenate the bath. During the period only small amounts of water normally need be added periodically. As such, it is thus seen that the cost to prepare an electrolyte bath of the types disclosed herein is very small, and the life thereof is considerably longer than for most previously employed baths used for the purposes described herein.

With the bath being very effective at room or ambient temperature, any fumes generated are greatly minimized, and are of a far less toxic or noxious nature than is the case with many prior baths, such as of nitric acid. Accordingly, the instant bath also provides a significant advantage from an ecology standpoint in minimizing problems with respect to both water and air pollution. In addition, even under stringent pollution laws where the limited oxygen and hydrogen fumes that are generated must nevertheless be removed, there are fume scrubbers commercially available that can eliminate such fumes much more completely, and with far less expense, than is the case with nitric, as well as sulfuric, chromic and hydrochloric acids, for example.

As previously pointed out, the aqueous electrolytic baths of the present invention advantageously do not require any additives, such as metal cations, often introduced into such baths in the form of metal salt compounds, to either initiate electro-chemical stripping action when the bath is fresh, or to sustain or continue such action as the bath produces a build-up in sludge with time and use. Concomitantly, while in certain applications a conventional acid inhibitor, such as glycerol, diethylene, glycol and the like, may be added in small amounts to increase the stable life of the bath, it has been found in practice that such inhibitors have not been necessary and, in fact, were found not to produce any noticeable benefits.

In summary, electrolytic stripping baths and processes have been disclosed herein that are ideally suited for stripping a large number of different types of metal deposits, such as copper, nickel, chromium, brass, tin, zinc, gold and silver, and the like, singularly, in selec-

tive combinations, or in the form of selective alloys thereof, from a base metal, such as titanium or tantalum, forming an article, without in any way attacking or otherwise adversely affecting the exposed surface of the latter. With the bath being very effective for the intended purpose at room or ambient temperature, this advantageously minimizes both evaporation of the bath constituents, and the generation of troublesome fumes as a result of electrochemical stripping.

What is claimed is:

1. The process of electro-stripping singularly and in selective combinations deposited metals, selected from the group consisting of copper, nickel, chromium, brass, tin, lead, zinc, gold and silver, from the surface of plated objects having base metals selected from the group consisting of titanium and tantalum, which comprises the steps of:

immersing the plated object in an electrolytic bath consisting essentially of an aqueous mixture of fluoboric acid, phosphoric acid and water, wherein the concentration of said fluoboric acid in said electrolytic bath is between 20 and 40 percent, by weight, and wherein the concentration of said phosphoric acid in said bath is between 5 and 25 percent, by weight, with the remainder of between 35 and 75 percent, by weight, being mainly of water, and

applying an electric current from the object, as anode, through the solution to a cathode until the plated metal on the object has been electro-stripped therefrom.

2. The process of electro-stripping in accordance with claim 1 wherein the concentration of said fluoboric acid in said electrolytic bath is between 28 and 32 percent, by weight, and wherein the concentration of said phosphoric acid in said bath is between 10 and 15 percent, by weight.

3. The process of electro-stripping singularly and in selective combinations deposited metals, selected from the group consisting of copper, nickel, chromium, brass, tin, lead, zinc, gold and silver, from the surface of articles having base metals selected from the group consisting of titanium and tantalum, which comprises the steps of:

immersing the plated article in an electrolytic bath consisting essentially, by weight, of an aqueous solution of 25 to 35 percent fluoboric acid, 10 to 20 percent phosphoric acid, and the remainder of 45 to 65 percent being mainly of water, and

applying an electric current from the article, as anode, through the bath to a cathode until the plated metal has been electro-stripped from the article.

4. The process of electro-stripping in accordance with claim 3 wherein the concentration of said fluoboric acid in said electrolytic bath is approximately 29 percent, by weight, and wherein said phosphoric acid in said bath is approximately 13 percent, by weight, with the remainder water.

5. The process of electro-stripping singularly and in selective combinations electro-deposited metals, selected from the group consisting of copper, nickel, chromium, brass, tin, lead, zinc, gold and silver, from such plated articles having base metals selected from the group consisting of titanium and tantalum, which comprises the steps of:

immersing the plated article in an electrolytic bath consisting essentially, by volume, of an aqueous so-

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lution the equivalent of 50 to 60 percent of a 39.9° BAUME' fluoboric acid, the equivalent of 12 to 17 percent of a 53.2° BAUME' phosphoric acid, and from 23 to 33 percent water, and applying an electric current from the article, as anode, through the bath to a cathode until the plated metal has been electro-stripped from the article and disintegrates into the solution.

6. An electrolytic bath for stripping plated metals from a different base metal consisting essentially of fluoboric acid, phosphoric acid and water, wherein the concentration of said fluoboric acid in said bath is between 20 and 40 percent, by weight, and wherein said phosphoric acid in said bath is between 5 and 25 percent, by weight, with the remainder of between 35 and

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75 percent, by weight, being mainly of water.

7. An electrolytic bath in accordance with claim 6 wherein the concentration of said fluoboric acid in said bath is between 28 and 30 percent, by weight, and wherein said phosphoric acid in said bath is between 12 and 14 percent, by weight, with the remainder of between 56 and 60 percent, by weight, being mainly of water.

8. An electrolytic solution for stripping metals from a different base metal consisting essentially, by volume, of an aqueous mixture the equivalent of 50 to 60 percent of a 39.9° BAUME' fluoboric acid, the equivalent of 12 to 17 percent of a 53.2° BAUME' phosphoric acid, and from 23 to 33 percent water.

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