

(51) International Patent Classification:
C25D 11/02 (2006.01)(21) International Application Number:
PCT/CN2011/076264(22) International Filing Date:
24 June 2011 (24.06.2011)

(25) Filing Language: English

(26) Publication Language: English

(71) Applicant (for all designated States except US): **APPLE INC.** [US/US]; 1 Infinite Loop, M/s 40-pat, Cupertino, California 95014-2084 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): **YAO, Zhicong** [CN/US]; 1 Infinite Loop, Ms 305-1pd, Cupertino, California 95014 (US). **CHANG, Chi-Hsiang** [CN/CN]; Muzhali, 9 Linjiukang St., 24 Xiang, Building 11, Apt.14, Taiwan, Wenshan District, Taipei, Taiwan 116 (TW).(74) Agent: **CCPIT PATENT AND TRADEMARK LAW OFFICE**; 8th Floor, Vantone New World Plaza, 2 Fuchengmenwai Street, Xicheng District, Beijing 100037 (CN).

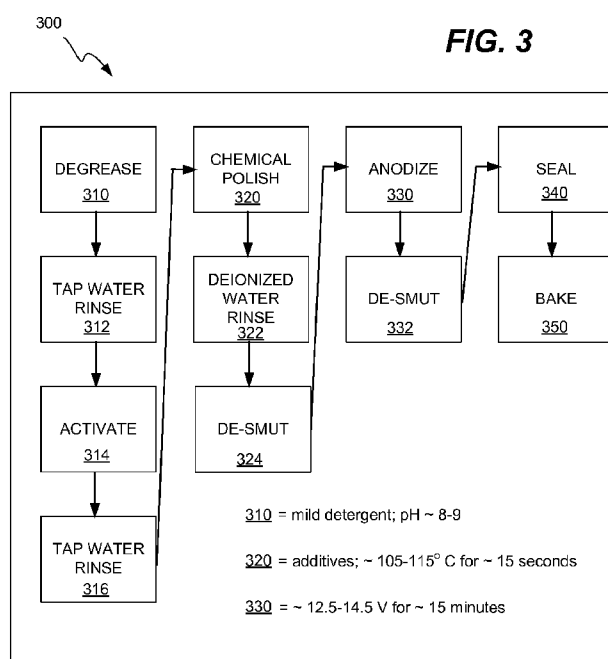
(81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: COSMETIC DEFECT REDUCTION IN ANODIZED PARTS



(57) **Abstract:** A system and process for reducing cosmetic defects such as black lines, and otherwise improving the final cosmetic appearance of anodized parts is disclosed. The process includes degreasing an aluminum or other metal part in a neutral to low alkaline solution having a mild detergent, chemically polishing the metal part with a specialized solution having one or more additives at an increased temperature for a reduced amount of time. An activating step can also be performed as part of the overall process. Tap water rinse, de-ionized water rinse, de-smut, seal and bake procedures can also be performed on the metal part.

COSMETIC DEFECT REDUCTION IN ANODIZED PARTS

TECHNICAL FIELD

[0001] The present invention relates generally to manufacturing and part formation. More particularly, the present embodiments relate to improving the
5 final cosmetic appearance of anodized metal parts.

BACKGROUND

[0002] The outward appearance of a computing system or device is important to many consumers. In particular, an aesthetically pleasing and cosmetically clean device that is free of any seams, burrs, marks or other irregularities can be
10 perceived as being nicer and more desirable than devices that are not so cosmetically clean. Creating an outward appearance that is aesthetically pleasing and durable for computing systems and other devices that include metal parts can sometimes include the use of anodized metal parts.

[0003] It is generally well known that anodizing metal parts can improve the
15 outer surfaces of such parts by hardening and strengthening the surfaces, increasing resistance to corrosion and wear, and providing better adhesion for paint primers and adhesives, among other advantages. In addition, the outward appearance of an anodized surface tends to be uniform and aesthetically pleasing, particularly with respect to aluminum. It is also generally well known that
20 anodization tends to change the crystal structure or other microscopic texture of the metal material. This is generally not a problem though, as the advantages of anodizing aluminum and other metals can outweigh any expenses or drawbacks in many cases.

[0004] Unfortunately, the outward cosmetic appearance of an anodized metal
25 part or system of parts may not be pristine or seamless where the microscopic structure of the part or parts contains defects, irregularities, or foreign materials, such as trace amounts of Ti, B, Cu, Fe, Si and the like. The existence of such defects or irregularities, which can occur at weld regions, seams or cracks, for example, can become manifested upon anodization. This can result in the outward
30 cosmetic appearance of the anodized metal part or parts having black lines, white lines, pits or other flaws that are revealed or magnified as a result of the anodization process. While some amount of minor "black line" flaws such as these may be tolerable in some cases, such outcomes have a lowered aesthetic

value and can often result in an increased amount of part rejection or recycling in the manufacturing process.

[0005] While many designs and techniques used with respect to anodizing metal parts and components have generally worked well in the past, there is
5 always a desire to provide further designs and techniques for metal part anodization that result in a higher incidence of acceptable and cosmetically pleasing finished parts. In particular, what is desired are improved designs and techniques that enable the anodization of metal parts having inherent internal defects or flaws that still result in a final anodizing finish that is cosmetically
10 pleasing and less likely to result in part rejection or recycling for cosmetic reasons.

SUMMARY

[0006] The present application describes various embodiments regarding systems and methods for the anodization of metal parts having inherent internal defects or flaws that still result in a final anodizing finish that is cosmetically
15 pleasing and less likely to result in part rejection or recycling for cosmetic reasons. This can be accomplished at least in part through the use of manufacturing systems and methods that utilize specialized degreasing, chemical polishing and anodizing processes for the treatment of metal parts.

[0007] In various embodiments, a system adapted for the manufacture of
20 anodized metal parts can include at least a degreasing station, a chemical polishing station, and an anodizing station. The degreasing station can be adapted to degrease a separate metal part using an alkaline solution with a mild detergent, wherein the alkaline solution has a pH that ranges from about 8 to 9. The chemical polishing station can be adapted to chemically polish the degreased
25 metal part at a temperature that ranges from about 105 to 115 degrees C and for a period of about 15 to 30 seconds, by using a chemical polishing solution with one or more specialized additives. The anodizing station can be adapted to anodize the chemically polished part for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts. More particularly, the chemical polishing
30 can take place for about 15 seconds, while the anodizing can take place for about 15 minutes.

[0008] In various detailed embodiments, the system can be specially adapted to be used on aluminum parts, although other types of metal parts can also be

processed. Additional system stations can include an activating station adapted to neutralize or activate the metal part between the degreasing and chemically polishing steps, one or more rinsing stations adapted to rinse the metal part with tap water after the part has been processed through the degreasing station, and one
5 or more deionized rinsing stations adapted to rinse the metal part with deionized water after the part has been processed through the chemical polishing station. Still further system stations can include a de-smutting station adapted to de-smut the anodized metal part in a nitric acid solution at a temperature of about 25 degrees C and for a period of about 30 seconds, a sealing station adapted to seal
10 the anodized metal part using an acetate solution that is applied at a temperature that ranges from about 92 to 96 degrees C and for a period of about 15 minutes, and a baking station adapted to bake the sealed metal part at a temperature that ranges from about 85-90 degrees C and for a period of about 10 to 15 minutes. In one particular embodiment, the chemical polishing solution comprises by weight
15 about 76-82% phosphoric acid, 18-20% sulfuric acid, 1-5% nitric acid, 1-1.5% corrosion inhibiting additive, 1-1.5% buffering agent, and a trace amount of fatty alcohol ethoxyl compound.

[0009] In further embodiments, various methods of manufacturing metal parts having aesthetically pleasing surface finishes are provided. Method steps can
20 include degreasing the metal part, chemically polishing the degreased metal part, and anodizing the chemically polished part. In particular, degreasing can be performed using an alkaline solution having a mild detergent and a pH of about 8 to 9. Also, chemical polishing can be performed at a temperature that ranges from about 105 to 115 degrees C and for a period of about 15 to 30 seconds using a
25 solution having one or more specialized additives. Further, anodizing can be performed for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts. More particularly, the chemical polishing can take place for about 15 seconds, while the anodizing can take place for about 15 minutes. Again, the subject metal parts can be aluminum, for example, and can be designed to be used
30 for a computing device. Other metals and types of devices are also possible.

[0010] Additional process steps can include activating the degreased metal part between the degreasing and chemically polishing steps, rinsing the degreased metal part with tap water after the degreasing step, rinsing the chemically polished

metal part with deionized water after the chemically polishing step, de-smutting the anodized metal part in a nitric acid solution at a temperature of about 25 degrees C and for a period of about 30 seconds, sealing the anodized metal part using an acetate solution that is applied at a temperature that ranges from about 92 to 96 degrees C and for a period of about 15 minutes, and baking the sealed metal part at a temperature that ranges from about 85-90 degrees C and for a period of about 10 to 15 minutes.

[0011] In still further embodiments, a computing device can include a processor, one or more input components coupled to the processor, one or more output components coupled to the processor, and an outer housing including at least one anodized metal component. In particular, the anodized metal component or components can have been degreased in an alkaline solution having mild detergent and a pH that ranges from about 8 to 9, chemically polished at a temperature that ranges from about 105 to 115 degrees C and for a period of about 15 to 30 seconds using a solution having one or more specialized additives, and anodized for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts. More particularly, the chemical polishing can take place for about 15 seconds, while the anodizing can take place for about 15 minutes. The anodized metal component or components can include anodized aluminum. Also, the outer housing can include one or more microstructure defects that are not made readily apparent as a result of the anodization process.

[0012] Other apparatuses, methods, features and advantages of the invention will be or will become apparent to one with skill in the art upon examination of the following figures and detailed description. It is intended that all such additional systems, methods, features and advantages be included within this description, be within the scope of the invention, and be protected by the accompanying claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] The included drawings are for illustrative purposes and serve only to provide examples of possible structures and arrangements for the disclosed inventive systems and methods for the anodization of metal parts. These drawings in no way limit any changes in form and detail that may be made to the invention

by one skilled in the art without departing from the spirit and scope of the invention.

[0014] FIG. 1A illustrates in front elevation view an exemplary computing device having one or more outer metal parts that can be treated according to the various embodiments of the present invention.

[0015] FIG. 1B illustrates in side elevation view the exemplary computing device of FIG. 1A.

[0016] FIG. 2 illustrates in block diagram format an exemplary metal part finishing system.

10 [0017] FIG. 3 illustrates in block diagram format an alternative metal part finishing system according to one embodiment of the present invention.

[0018] FIG. 4 provides a flowchart of one way of manufacturing an anodized metal part.

15 [0019] FIG. 5 provides a flowchart of an alternative way of manufacturing an anodized metal part according to one embodiment of the present invention.

DETAILED DESCRIPTION

[0020] Exemplary applications of apparatuses and methods according to the present invention are described in this section. These examples are being provided solely to add context and aid in the understanding of the invention. It will thus be apparent to one skilled in the art that the present invention may be practiced without some or all of these specific details. In other instances, well known process steps have not been described in detail in order to avoid unnecessarily obscuring the present invention. Other applications are possible, such that the following examples should not be taken as limiting.

25 [0021] In the following detailed description, references are made to the accompanying drawings, which form a part of the description and in which are shown, by way of illustration, specific embodiments of the present invention. Although these embodiments are described in sufficient detail to enable one skilled in the art to practice the invention, it is understood that these examples are not limiting; such that other embodiments may be used, and changes may be made without departing from the spirit and scope of the invention.

[0022] The present disclosure generally relates to the manufacture of various metallic housings and other computer components, as well as a manufacturing

system and process adapted to treat and anodize such metal components.

Although the following specific embodiments have been described with respect to a computer or computing device, it will be readily appreciated that other metal parts and components may be similarly treated without departing from the inventive features described herein and claimed below. For example, such parts can be used for the exteriors of refrigerators, valves, toys, or any other item having anodized parts that may be suitable. Further alternatives will be readily appreciated by those skilled in the art.

[0023] Referring first to FIGS. 1A and 1B an exemplary computing device having one or more outer metal parts that can be treated according to the various embodiments of the present invention is illustrated in front elevation and side elevation views respectively. Computing device 10 can be, for example, an iMac® personal computer commercially available from Apple, Inc. It will be readily understood, however, that a wide variety of computing devices or other items having metal components are similarly applicable for the systems and processes of the present invention. Computing device 10 can include an outer housing 20 comprising one or more anodized metal parts. For example, outer housing 20 can be formed from anodized aluminum. A display device 30 can be contained within outer housing 20. Outer housing 20 can have a frontally offset bottom portion 21 that borders a bottom of the display region, as well as a raised frame 22 that surrounds the rest of the display region. A recessed set back region (not shown) can be formed above the bottom portion 21 and/or just inside the frame 22 of the outer housing 20. In addition, a stand 40 or other similar structure can be used to support the entire computing device 10.

[0024] As seen in FIGS. 1A and 1B, the overall structure and arrangement of the frame 22 and bottom portion 21 of outer housing 20 generally results in a relatively simple way of securing and supporting a display cover in a suitable location for viewing the display device 30 therethrough. As will be readily appreciated, outer housing 20 can also contain various additional computer components therewithin, such as one or more processors, storage units, speakers, additional displays or indicators, buttons or other input devices, video cards, sound cards, power inlets, various ports, and the like. In some embodiments, the entire outer housing 20 can present the appearance that it is formed from a single

piece of material, despite the fact that the housing may be formed from two or more parts that are welded, adhered or otherwise joined together. For example, frontally offset bottom portion 21 may include a front portion that is welded, adhered or otherwise affixed to the rest of the outer housing 20. In such instances, one or more cosmetic imperfections or defects may result at the joined region 23 when the combined parts 20, 21 are then anodized or otherwise finished.

[0025] Although a desktop computing device 10 has been shown for purposes of illustration, it will be readily appreciated that many other forms of computing devices can similarly have outer metal components that are suitable for the finishing systems and methods provided herein. Such other devices can include, for example, media playback devices, cellular telephones, tablet computing devices and the like. Furthermore, numerous other metal parts and components that are used for items other than computing devices may also be treated and finished using the various systems and methods disclosed herein.

[0026] Moving next to FIG. 2, an exemplary metal part finishing system is illustrated in block diagram format. Metal part finishing system 200 can include a plurality of stations adapted to treat or process metal parts. Such stations can involve baths having solution therein, piping, nozzles and other fluid delivery components, drains, heaters, voltage applicators and the like, as will be readily appreciated. An initial station can be degrease station 210, which can be followed by a tap water rinse station 212. A suitable degreasing formula for station 210 can be composed of, for example, sodium hydroxide, sodium carbonate and a surface activation component, which can be at a concentration of about 0.5 g/l, for example.

[0027] An alkaline etch station 220 can then be set up to provide an alkaline etch for degreased metal parts. The alkaline etchant can involve a sodium hydroxide based solution having a relatively high alkaline pH of about 13-18. Another tap water rinse station 222 can be provided after the alkaline etch station 220. A de-smut station 224 can also be provided, which can involve a nitric acid de-smut solution. Another tap water rinse station 226 can then follow the de-smut station 224. As will be readily appreciated, rinsing may be performed at the same station in some arrangements, such that stations 212, 222 and 226 can actually be the same station.

[0028] A chemical polish station 230 can be used to facilitate the chemical polishing of the metal parts. The chemical polishing solution can be, for example, sulfuric acid at 250g/l and phosphoric acid at 750 g/l. Polishing can be performed at a temperature of about 78-86 degrees C for about 20-70 seconds. A deionized water rinse station 232 can then be provided after the chemical polish station 230, as will be readily understood.

[0029] An anodize station 240 can then be used to anodize the chemically polished parts. Anodizing can be conducted, for example, using 220 g/l sulfuric acid for about 23-26 minutes, and at a voltage of about 14.5 to 15.5 volts. Subsequent to the metal part anodizing, seal station 250 and bake station 260 can also be provided, with the functions, temperatures and times used for these final stations being generally well known by those skilled in the art.

[0030] Continuing now with FIG. 3, an alternative metal part finishing system according to one embodiment of the present invention is similarly shown in block diagram format. Metal part finishing system 300 is similar in some regards with respect to system 200, but has several notable differences. In particular, the details regarding degrease station 310, chemical polish station 320 and anodize station 330 should be noted as being significantly different than those for system 200. Further, no alkaline etch station is provided, while a surface activation station is added instead.

[0031] Starting with degrease station 310, a preferable degreasing formula for station can be composed of, for example, a mild detergent contained within a mild alkaline solution having a pH of about 8 to 9. This can result in an effect degreasing of the metal parts without exposing the parts to the harsher nature of a highly alkaline solution such as that which is used in the previous example. In one particular example, the mild detergent can be the Upland 102 model industrial detergent provided by the HangZhou Ylang Chemical Company of China. A tap water rinse station 312 can then be used after the metal parts have been degreased in degrease station 310. Tap water rinse station 312 can involve the use of three separate cleaning tanks for an efficient and effective rinsing of the metal parts. In addition, ultrasonic vibrations can be provided for the fluids in station 312, as well as for any of stations 310-340, as may be desired for a given manufacturing system.

[0032] An activation station 314 can then be provided to activate the surface of the metal parts after the degreasing and rinsing stations. As a particular example, a 150 g/l nitric acid solution can be applied at about 25 degrees C for about 30 seconds to result in an effective activation of the degreased metal parts.

5 Another tap water rinse station 316 can then be provided. In some instances, tap water rinse stations 312 and 316 can actually be the same station if desired.

[0033] A chemical polish station 320 can then be provided for the chemical polishing of the metal parts. The chemical polishing solution used can contain one or more specialized additives. In one particular example, the additives can be found in the 2022 product model metal working liquid provided by the HangZhou PShang Chemical Company of China. By using these particular additives, the resulting specialized chemical polishing solution can then comprise by weight about 76-82% phosphoric acid, 18-20% sulfuric acid, 1-5% nitric acid, 1-1.5% corrosion inhibiting additive, 1-1.5% buffering agent, and a trace amount of fatty alcohol ethoxyl compound. The actual polishing using this specialized solution can be conducted at a temperature that ranges from about 105 to 115 degrees C, and for a period of about 15 to 30 seconds, which is generally hotter and shorter than the previous example. More particularly, the chemical polishing can take place for about 15 seconds. A deionized water rinse station 322 can then be provided after the chemical polish station 320, as will be readily appreciated. A de-smut station 324 can then be used to de-smut the metal parts. Such a de-smut can involve a nitric acid solution of a concentration less than about 100g/l, and can be conducted at about 25 degrees C for about 30 seconds, for example. Other de-smut details or variations are also possible.

25 [0034] An anodize station 330 can then be used to anodize the chemically polished parts. Anodizing can be conducted, for example, using 200 g/l sulfuric acid for about 15 to 20 minutes, and at a voltage of about 12.5 to 14.5 volts. More particularly, the anodizing can take place for about 15 minutes. In comparison with the foregoing example, this is a less concentrated solution that is being used at a lower voltage for a shorter period of time. Another de-smut station 332 can then be used to de-smut the metal parts after anodization. Again, such a de-smut can involve a nitric acid solution of a concentration less than about 100g/l, and can be conducted at about 25 degrees C for about 30 seconds, for example.

[0035] A seal station 340 can then be used to provide a sealing function. Sealing can be performed, for example, using an acetate solution at about 95 degrees C and for about 10 minutes. A bake station can then be used to provide a baking function. Baking can be performed, for example, at about 85-90 degrees C and for about 10 minutes as well.

[0036] As a result of the different details in metal part finishing system 300 with respect to the foregoing example, such as those regarding degrease station 310, chemical polish station 320 and anodize station 330, among others, improved results in the final cosmetic appearance of the metal parts can be realized. In particular, many black lines, white lines, pits and other cosmetic imperfections are not so readily apparent, despite the presence of underlying microscopic flaws or issues that ordinarily result in the manifestation of such cosmetic issues. It has thus been determined that use of system 300 in FIG. 3, as well as the corresponding process in FIG. 5 below, results in the significantly improved cosmetic appearance of anodized parts. That is to say, where the use of system 200 and the corresponding process in FIG. 4 below may result in more noticeable cosmetic flaws in a finished anodized metal part, the use of system 300 and the corresponding process in FIG. 5 does not. Accordingly, where a metal part includes one or more microstructure defects, such defects are not made readily apparent in a final cosmetic sense as a result of the anodization process used in system 300 and FIG. 5.

[0037] FIG. 4 provides a flowchart of a typical way of manufacturing an anodized metal part. This flowchart generally represents a process that can be performed using the system 200 set forth above in FIG. 2. After an initial step 400, the metal part can be degreased using a degreasing formula at process step 402. Such a degreasing formula can be composed of, for example, sodium hydroxide, sodium carbonate and a surface activation component. A tap water rinse can also be performed after the degreasing step 402. At the following process step 404, an alkaline etching procedure is performed using a sodium hydroxide based solution having a relatively high alkaline pH of about 13-18. Again, a tap water rinse can be performed after this alkaline etching step 404.

[0038] At subsequent process step 406, a de-smut can be conducted on the metal part, with such a de-smut utilizing a 30-40% by weight nitric acid solution.

This can be done at room temperature for about 30-60 seconds, for example.

Again, a tap water rinse can be performed after this de-smut step 406. A chemical polish can then be conducted on the metal part at process step 408. Such a chemical polish can be done using a solution containing sulfuric acid at 250g/l and phosphoric acid at 750 g/l at a temperature of about 78-86 degrees C and for about 20-70 seconds. A water rinse can also be performed after this chemical polish step 408, and this may involve the use of deionized water.

[0039] At the following process step 410, the metal part can then be anodized using sulfuric acid at a concentration of 220 g/l for about 23-26 minutes, and at a voltage of about 15 (+/- 0.5) volts. Subsequent process step 412 can involve sealing the anodized metal part in a nickel acetate and water solution at a temperature of about 92-96 degrees C for about 15 minutes. Process step 414 can then involve baking the sealed part at about 80-100 degrees C for about 10-15 minutes. The method then ends at end step 416.

[0040] Finishing now with FIG. 5, a flowchart is provided depicting an alternative way of manufacturing an anodized metal part according to one embodiment of the present invention. It will be understood that the provided steps are shown only for purposes of illustration, and that other steps may be included in the process, as may be desired. Furthermore, the order of steps may be changed where appropriate and not all steps need be performed in various instances. For example, de-smut step 516 may be performed earlier in the process, as may be desired. In other examples, various added water rinsing steps can also be performed and repeated throughout the process.

[0041] After a start step 500, a suitable metal part can be degreased at process step 502. Again, this can be an aluminum part, although other types of metal can also be used. As in the foregoing embodiment of FIG. 3, degreasing can be performed in a mild alkaline solution having a pH of about 8 to 9. More particularly, the pH can be about 8.5. Other details regarding the degreasing can be the same or substantially similar to those provided above in the embodiment of FIG. 3. Following degreasing, the metal part can then be optionally cleaned or rinsed with tap water at process step 504. Such a tap water rinse can take place in a three tank process, for example.

[0042] At subsequent process step 506, the metal part can then be activated in a nitric acid solution. In one example, a 150 g/l nitric acid solution can be applied at about 25 degrees C for about 30 seconds. Another optional tap water rinse can then be performed at process step 508. Again, such a tap water rinse can take
5 place in a three tank process. A chemical polishing of the metal part can then be conducted at process step 510. Again, as in the foregoing embodiment of FIG. 3, chemical polishing can be performed using a chemical polishing solution with one or more specialized additives, and can be conducted at a temperature that ranges from about 105 to 115 degrees C, and for a period of about 15 to 30 seconds.
10 Other details regarding the chemical polishing can be the same or substantially similar to those provided above in the embodiment of FIG. 3.

[0043] A deionized water rinse can then take place at process step 512. This deionized water rinse can similarly take place in a three tank process. A de-smut can then be performed on the metal part at process step 514. Such a de-smut can
15 involve a nitric acid solution of a concentration less than about 100g/l, and can be conducted at about 25 degrees C for about 30 seconds. At subsequent process step 516, the metal part can be anodized. In particular, anodization can be performed using sulfuric acid at 200 g/l for about 15 to 20 minutes, and at a voltage that ranges from about 12.5 to 14.5 volts. More particularly, a voltage of
20 about 13.5 volts can be used. Another de-smut can then be performed on the metal part at process step 518, with such a de-smut being the same or similar to the de-smut of step 514.

[0044] A sealing function can then take place at process step 520. Sealing can be performed using an acetate solution at about 95 degrees C and for about 10
25 minutes. Baking can then take place at process step 522, with such baking being performed at about 85-90 degrees C and for about 10 minutes as well. The method then ends at end step 524. In addition to the foregoing details, it will be readily appreciated that one or more of the solution based steps or rinses can optionally be conducted using ultrasonically vibrating tanks or baths.

30 [0045] Although the foregoing invention has been described in detail by way of illustration and example for purposes of clarity and understanding, it will be recognized that the above described invention may be embodied in numerous other specific variations and embodiments without departing from the spirit or

essential characteristics of the invention. Certain changes and modifications may be practiced, and it is understood that the invention is not to be limited by the foregoing details, but rather is to be defined by the scope of the appended claims.

WHAT IS CLAIMED IS:

1. A system adapted for the manufacture of anodized metal parts, the system comprising:
 - a degreasing station adapted to degrease a separate metal part, said
 - 5 degreasing station having an alkaline solution with a mild detergent, wherein the alkaline solution has a pH that ranges from about 8 to 9;
 - a chemical polishing station adapted to chemically polish the degreased metal part at a temperature that ranges from about 105 to 115 degrees C and for a period of about 15 to 30 seconds, said chemical polishing station having a
 - 10 chemical polishing solution with one or more specialized additives; and
 - an anodizing station adapted to anodize the chemically polished part for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts.
2. The system of claim 1, wherein said system is adapted to be used on aluminum parts.
- 15 3. The system of claim 1, further including:
 - an activation station adapted to activate the metal part between the degreasing and chemically polishing steps.
4. The system of claim 1, further including:
 - one or more rinsing stations adapted to rinse the metal part with tap water
 - 20 after the part has been processed through the degreasing station.
5. The system of claim 1, further including:
 - one or more deionized rinsing stations adapted to rinse the metal part with deionized water after the part has been processed through the chemical polishing station.
- 25 6. The system of claim 1, further including:
 - a de-smutting station adapted to de-smut the anodized metal part in a nitric acid solution at a temperature of about 25 degrees C and for a period of about 30 seconds.
7. The system of claim 1, further including:
 - 30 a sealing station adapted to seal the anodized metal part using an acetate solution that is applied at a temperature that ranges from about 92 to 96 degrees C and for a period of about 15 minutes.

8. The system of claim 1, further including:
a baking station adapted to bake the sealed metal part at a temperature that ranges from about 85-90 degrees C and for a period of about 10 to 15 minutes.
9. The system of claim 1, wherein the chemical polishing solution comprises
5 by weight about 76-82% phosphoric acid, 18-20% sulfuric acid, 1-5% nitric acid, 1-1.5% corrosion inhibiting additive, 1-1.5% buffering agent, and a trace amount of fatty alcohol ethoxyl compound.
10. A method of manufacturing a metal part having an aesthetically pleasing surface finish, comprising:
10 degreasing the metal part in an alkaline solution having a mild detergent, wherein the alkaline solution has a pH that ranges from about 8 to 9;
chemically polishing the degreased metal part at a temperature that ranges from about 105 to 115 degrees C and for a period of about 15 to 30 seconds, wherein said chemical polishing is accomplished using a solution having one or
15 more specialized additives; and
anodizing the chemically polished part for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts.
11. The method of claim 10, wherein the metal part is aluminum.
12. The method of claim 10, wherein the metal part is designed to be used for
20 a computing device.
13. The method of claim 10, further including the step of:
activating the degreased metal part between the degreasing and chemically polishing steps.
14. The method of claim 10, further including the step of:
25 rinsing the degreased metal part with tap water after the degreasing step.
15. The method of claim 10, further including the step of:
rinsing the degreased metal part with deionized water after the chemically polishing step.
16. The method of claim 10, further including the step of:
30 de-smutting the anodized metal part in a nitric acid solution at a temperature of about 25 degrees C and for a period of about 30 seconds.

17. The method of claim 10, further including the steps of:
sealing the anodized metal part using an acetate solution that is applied at a temperature that ranges from about 92 to 96 degrees C and for a period of about 15 minutes; and
- 5 baking the sealed metal part at a temperature that ranges from about 85-90 degrees C and for a period of about 10 to 15 minutes.
18. A computing device, comprising:
a processor;
one or more input components coupled to the processor;
- 10 one or more output components coupled to the processor; and
an outer housing including at least one anodized metal component,
wherein said at least one anodized metal component has been degreased in an alkaline solution having mild detergent and a pH that ranges from about 8 to 9,
chemically polished at a temperature that ranges from about 105 to 115 degrees C
- 15 and for a period of about 15 to 30 seconds using a solution having one or more specialized additives, and anodized for about 15 to 20 minutes and at a voltage that ranges from about 12.5 to 14.5 volts.
19. The computing device of claim 18, wherein said at least one anodized metal component comprises anodized aluminum.
- 20 20. The computing device of claim 18, wherein said outer housing includes one or more microstructure defects that are not made readily apparent as a result of the anodization process.

1/5

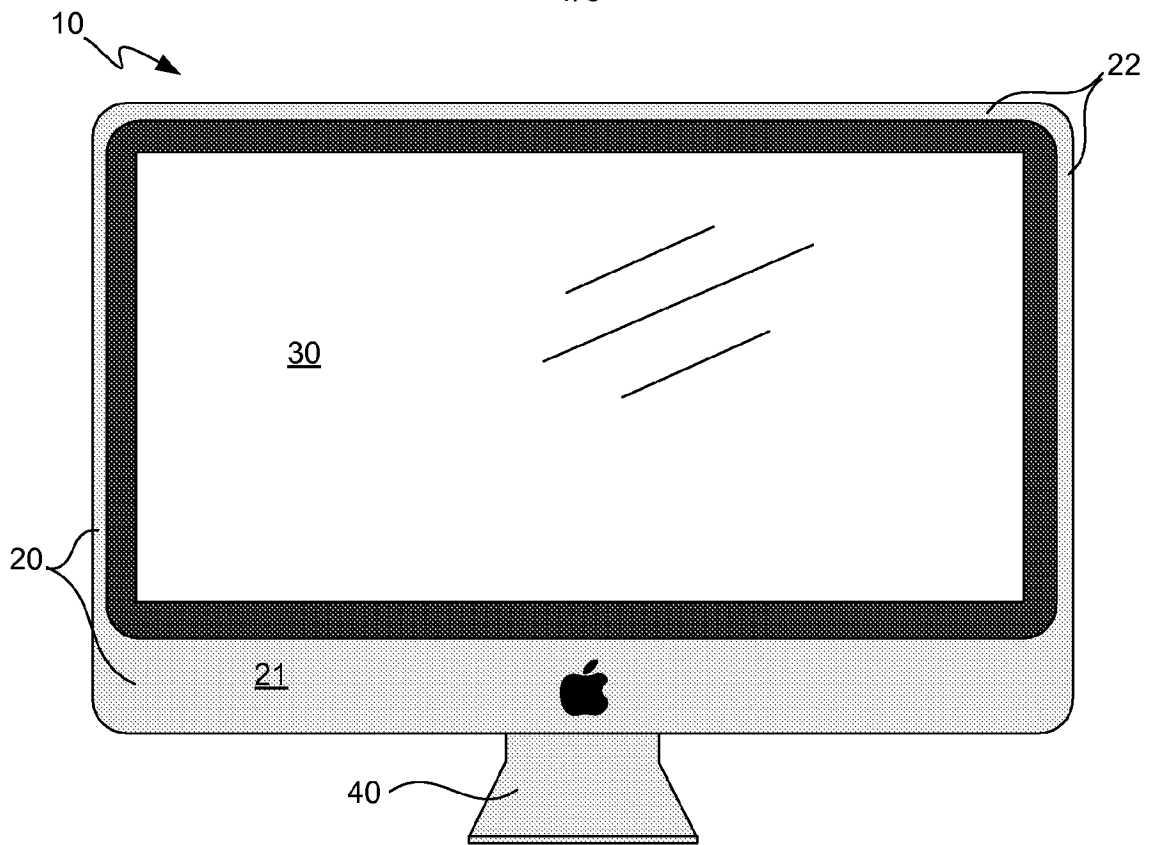


FIG. 1A

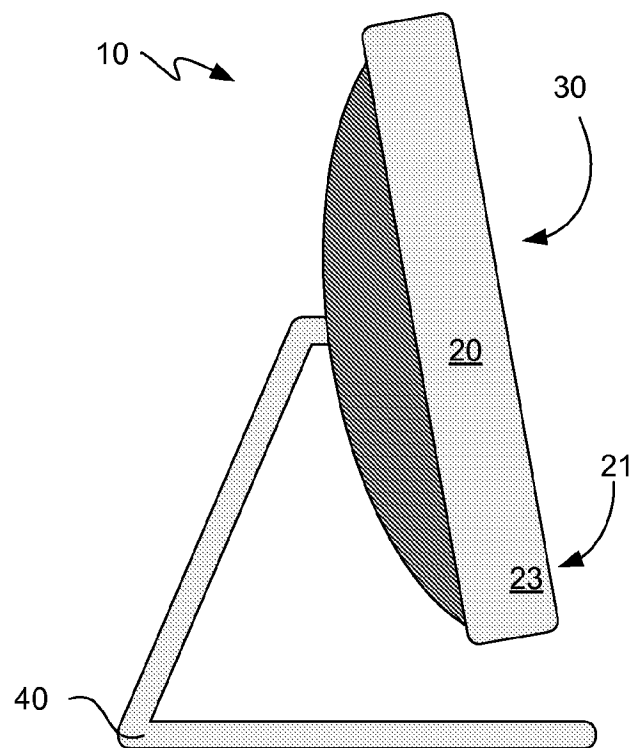
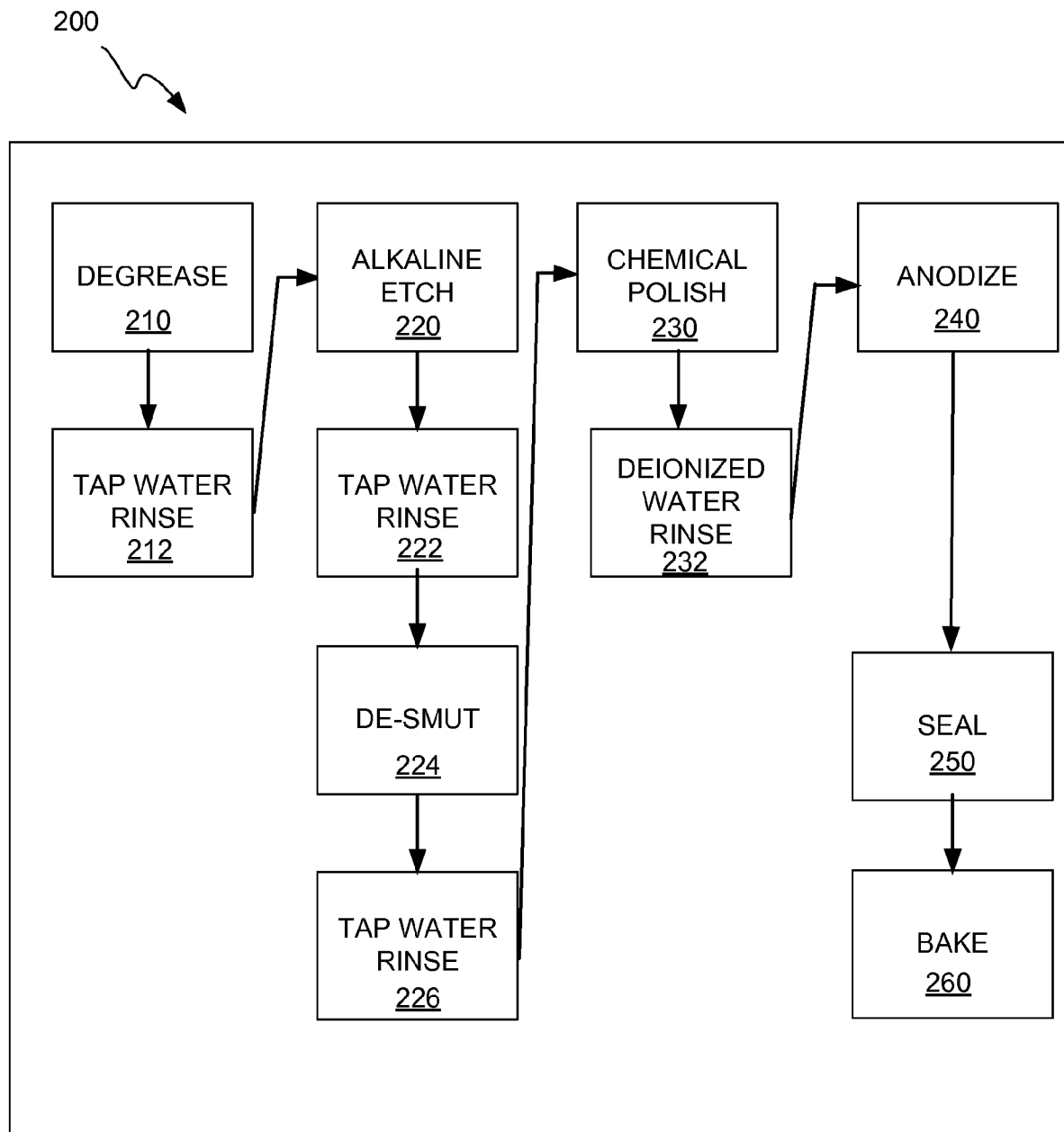
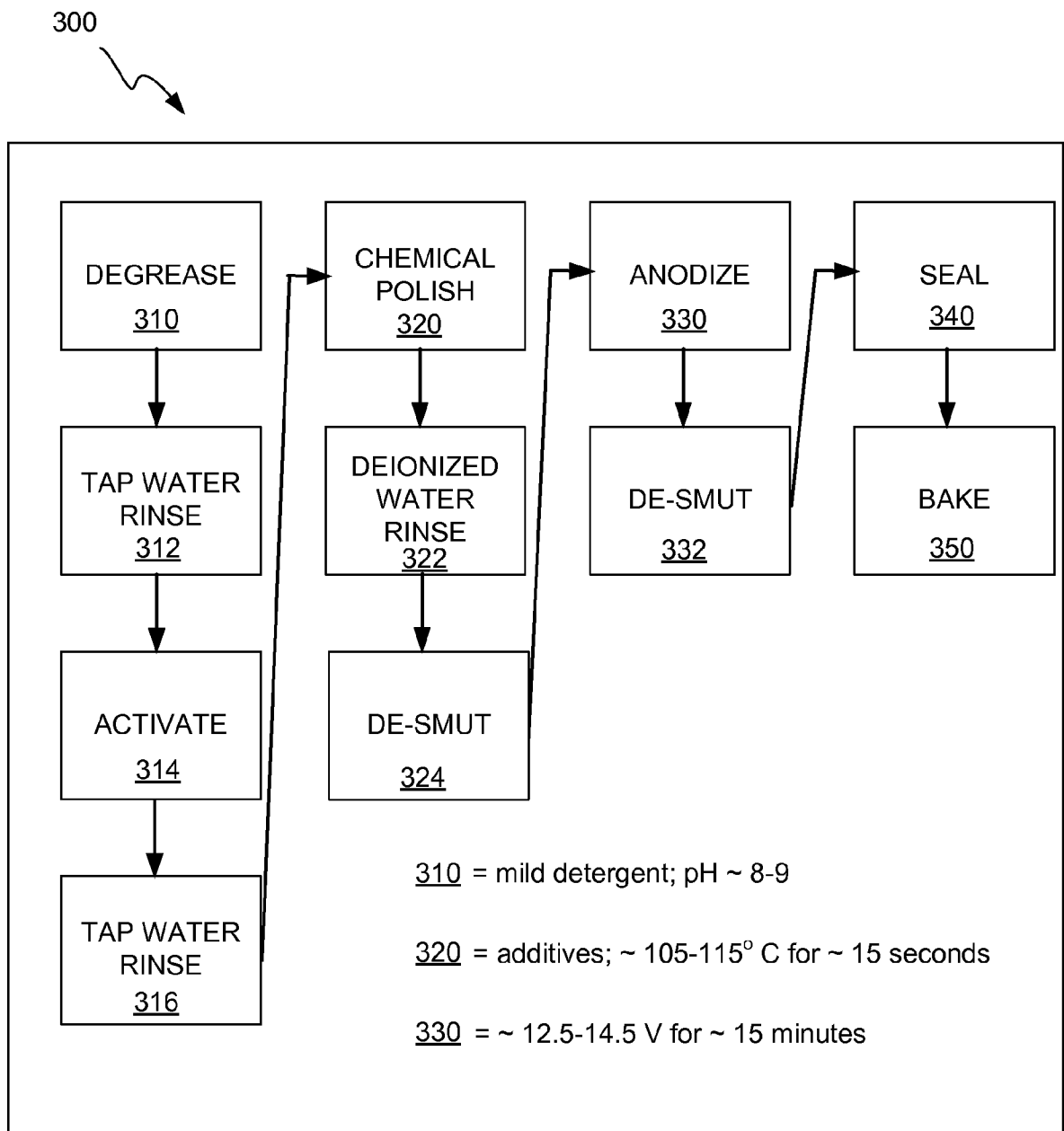


FIG. 1B

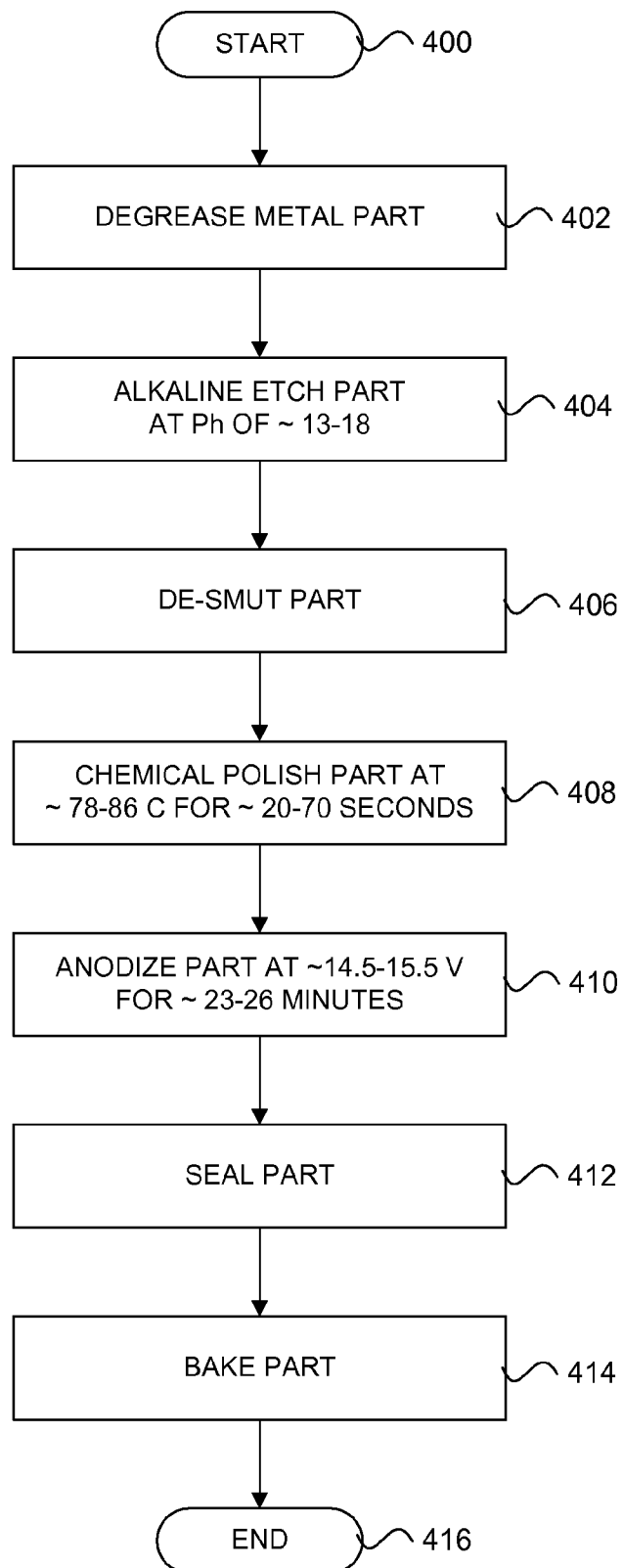
2/5

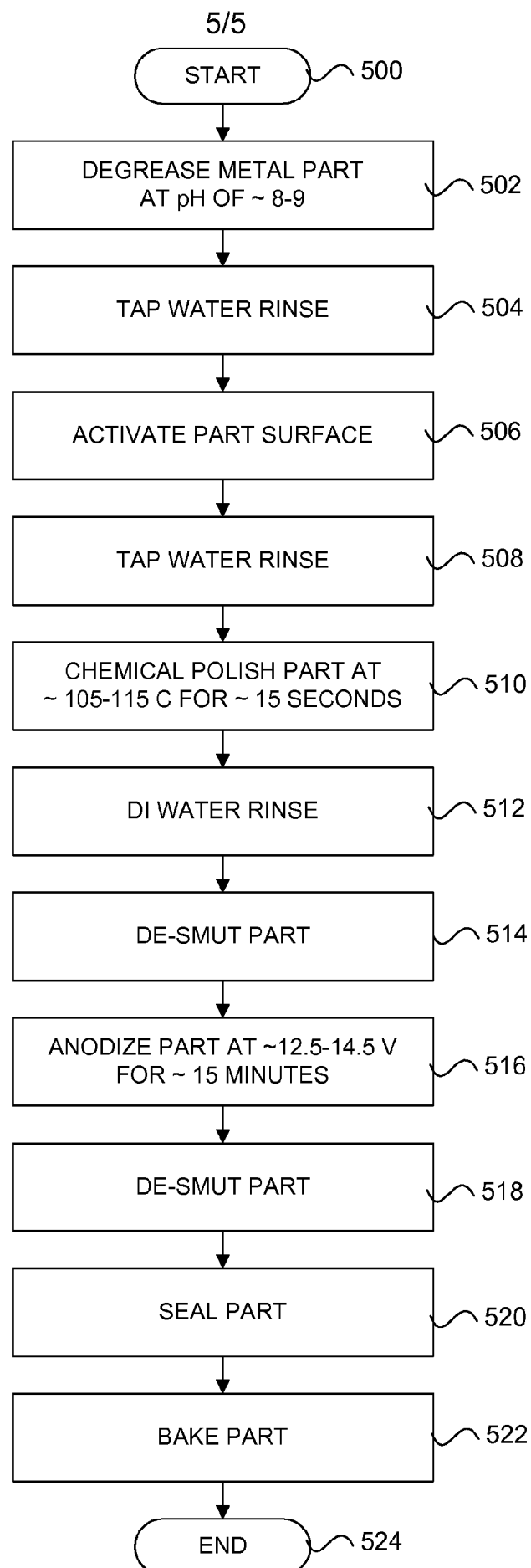
**FIG. 2**

3/5

**FIG. 3**

4/5

**FIG. 4**

**FIG. 5**

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2011/076264

A. CLASSIFICATION OF SUBJECT MATTER

C25D 11/02 (2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

C25D 11/-, C25D 7/-

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI; EPODOC; CNKI; CA; CNPAT: cosmetic, defect, anodize, parts, degreasing, aluminum, neutral, alkaline, solution, metal, polishing, voltage, rinse

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US2009/0091879A1(APPLE INC.), 09 Apr. 2009(09.04.2009), see abstract, claims 1-20	1-20
A	CN101515212A(APPLE INC.), 26 Aug. 2009(26.08.2009), see description page 2, paragraph 3 - page 13, paragraph 2	1-20
A	CN101839576A(YUNNAN YUXI JIALI SOLAR ENERGY EQUIP. CO. LTD.), 22 Sep. 2010(22.09.2010), see abstract	1-20
A	CN101845652A(CSIC. NO.12 RES. INST.), 29 Sep. 2010(29.09.2010), see claims 1-5	1-20

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

* Special categories of cited documents:	“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
“A” document defining the general state of the art which is not considered to be of particular relevance	“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
“E” earlier application or patent but published on or after the international filing date	“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
“L” document which may throw doubts on priority claim (S) or which is cited to establish the publication date of another citation or other special reason (as specified)	“&” document member of the same patent family
“O” document referring to an oral disclosure, use, exhibition or other means	
“P” document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search 02. Mar. 2012(02.03.2012)	Date of mailing of the international search report 05 Apr. 2012 (05.04.2012)
Name and mailing address of the ISA/CN The State Intellectual Property Office, the P.R.China 6 Xitucheng Rd., Jimen Bridge, Haidian District, Beijing, China 100088 Facsimile No. 86-10-62019451	Authorized officer NIE, Daobo Telephone No. (86-10)82245139

International application No.
PCT/CN2011/076264

Form PCT/ISA /210 (patent family annex) (July 2009)