United States Patent

[11] 3,616,341

[72] Inventor **John F. Jumer**
16 West 131 Timber Trails Drive,
Elmhurst, Ill. 60126

[21] Appl. No. **825,729**
[22] Filed **May 19, 1969**
[45] Patented **Oct. 26, 1971**

[54] **CHEMICAL AND ELECTROPOLISHING**
11 Claims, 5 Drawing Figs.

[52] **U.S. Cl.** **204/140.5,** 117/64, 134/150, 156/20, 204/212
[51] **Int. Cl.** **C23b 3/06,** C23b 5/68, C23g 1/36
[50] **Field of Search** 204/140.5, 141, 212, 140, 26; 117/64; 156/20; 134/23, 150

[56] **References Cited**

UNITED STATES PATENTS

1,076,424	10/1913	Held	204/26
1,850,426	3/1932	Tyrrell	204/26
2,526,951	10/1950	Kiefer, Jr.	204/140.5
2,665,247	1/1954	Jumer	204/140.5
2,705,191	3/1955	Jumer	156/21
2,861,937	11/1958	Jumer	204/212
3,041,227	6/1962	Jumer	156/21

FOREIGN PATENTS

912,069	12/1962	Great Britain

Primary Examiner—Howard S. Williams
Assistant Examiner—T. Tufariello
Attorney—Woodruff A. Morey

ABSTRACT: Large objects and the interiors of large vessels having areas to be polished which cannot be readily completely subjected to polishing action at one time, may be polished by the improved method on a partial area basis without creating or leaving any noticeable line of demarcation that would indicate that all areas had not been simultaneously subjected to the polishing action.

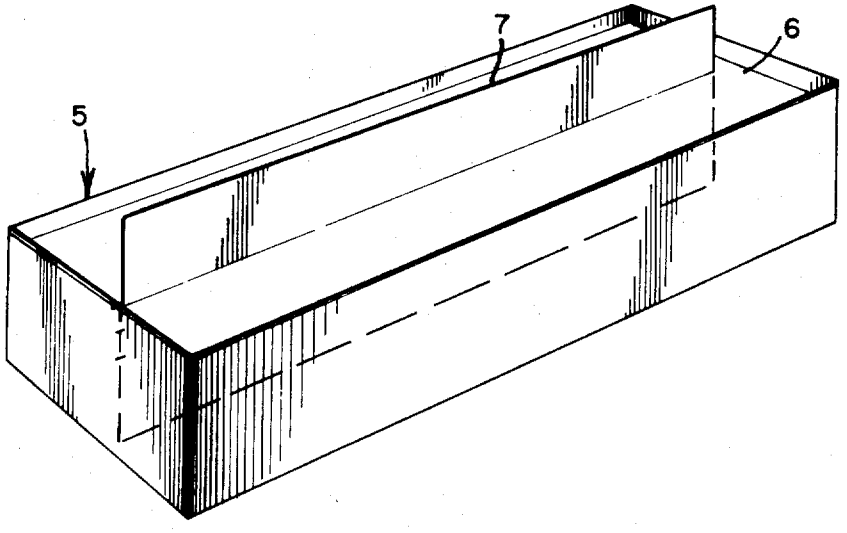


FIG. 1

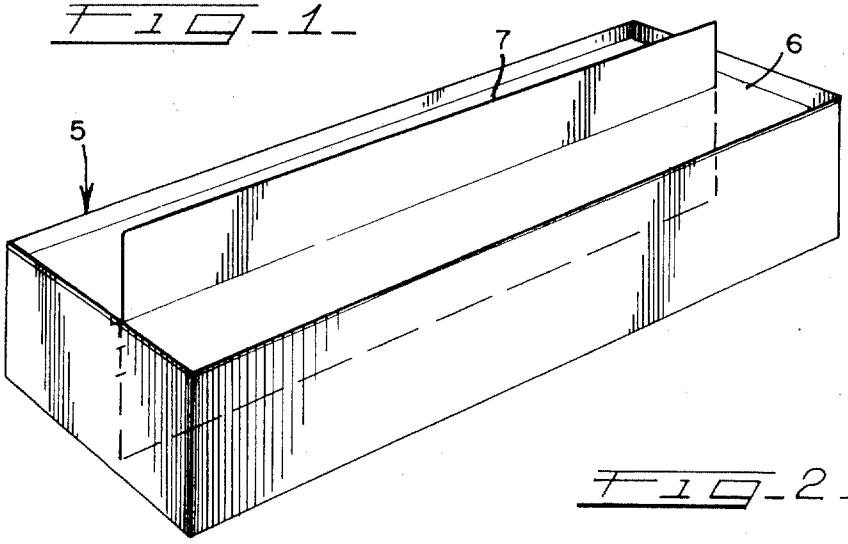
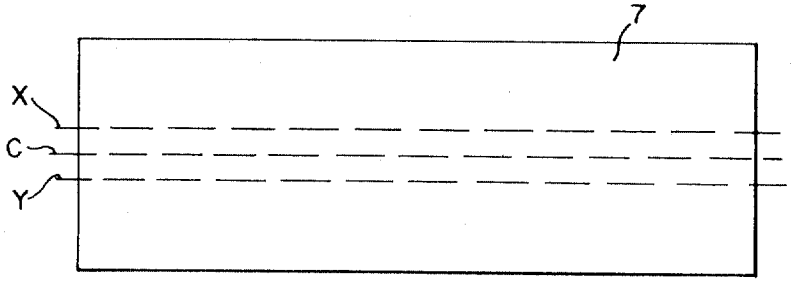


FIG. 2



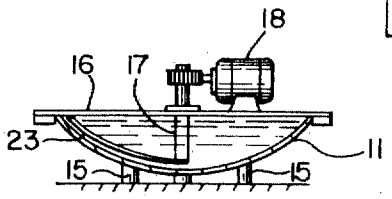


FIG. 4

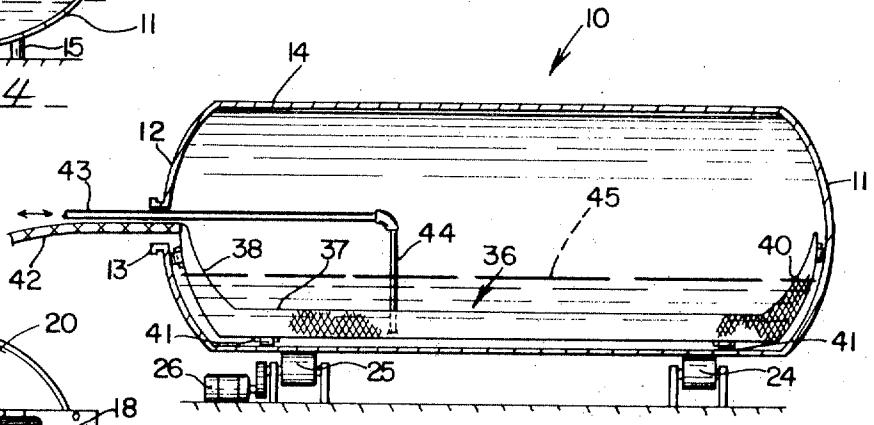


FIG. 5

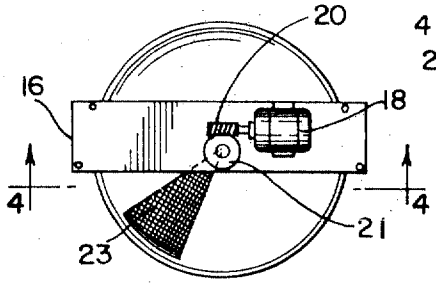


FIG. 3

INVENTOR
JOHN F. JUMER

CHEMICAL AND ELECTROPOLISHING

The art of chemical polishing and electropolishing of metal objects is well developed. For example, in my prior U.S. Pat. No. 2,861,937, dated Nov. 25, 1958, I have disclosed a method and apparatus for electropolishing the interior surfaces of large vessels. In my prior U.S. Pat. Nos. 2,705,191, dated Mar. 29, 1955 and 3,041,227, dated June 26, 1962, I have disclosed improved compositions and methods for chemically polishing the surfaces of aluminum objects. The present invention is concerned with the chemical or electropolishing of large surface areas of large objects of various shapes and sizes and including the interiors of large vessels in situations where the total area or areas to be polished cannot be accomplished in a single operation using available equipment or can be accomplished more readily in two operations. However, when a plurality of polishing operations are employed there will usually be a telltale line of demarcation in the polished surface the presence of which will often be unacceptable.

For example, there may be a requirement to electropolish the surface of a large metal sheet or plate when the polishing bath equipment available will not completely accommodate such an object so that it can be completely submerged in the polishing bath when standing of edge as required. In another example there may be a requirement to polish the interior of a large vessel without introducing enough of the polishing bath to come up to the centers of the ends so that the ends of the vessel will be polished at the same time the side wall surface is.

Accordingly, one important object of the present invention is the provision of a convenient and practical method of electropolishing or chemically polishing large surface areas of large objects in an insufficient amount of polishing bath to completely cover all of the surface or surfaces to be polished, but without leaving any line of demarcation to indicate that the polishing has not occurred uniformly and simultaneously over the entire surface or surfaces polished.

More specifically, an important object of the invention is the provision of a method of chemically or electrically polishing the surfaces of large objects by initially immersing them in a polishing bath to a depth above the horizontal center line and then lowering the bath level and/or raising the object at a uniform rate until the liquid level falls below the center line a distance equal to that at which the liquid level was initially above the center line, and then inverting the object and repeating the foregoing step.

A related important object of the invention is the provision of a method of chemically or electrically polishing the surfaces of large objects by initially immersing them in a polishing bath to a depth below the horizontal center line and then raising the bath level and/or lowering the object at a uniform rate until the liquid level rises above the center line a distance equal to that at which the liquid level was initially below the center line, and then inverting the object and repeating the foregoing step.

Another important object of the invention is to separately, chemically polish or electropolish the interiors of the opposing end walls of a vessel and then the end walls assembled to the vessel introducing a polishing bath into the same and rotating the bath, the amount of the bath being such that with the side wall being horizontal and the end walls upright the surface level of the bath falls substantially below the center line of the vessel, with the effective level of the bath being continuously changed during polishing (preferably lowered) until the interior of the side wall has been polished to the desired extent and then terminating the polishing action.

Certain other objects of the invention will, in part, be obvious and will in part appear hereinafter.

For a more complete understanding of the nature and scope of the invention, reference may now be had to the following detailed description thereof taken in conjunction with the accompanying drawings wherein:

FIG. 1 is a perspective view, taken from the side and top, of a chemical polishing bath tank with a large metal sheet to be polished in accordance with one embodiment of the invention resting on edge on the tank bottom;

FIG. 2 is an elevational view of the large sheet or plate to be polished which is shown in FIG. 1 and on which certain broken horizontal reference lines have been applied;

FIG. 3 is a top plan view of the interior of a vessel end wall with suitable apparatus mounted thereon for uniformly electropolishing the interior surface;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3; and,

FIG. 5 is a vertical longitudinal sectional view of a cylindrical vessel having closed end walls corresponding to the end wall shown in FIGS. 3 and 4 and shown supported for rotation about a horizontal axis with electropolishing elements suitably installed therein.

Referring to FIGS. 1 and 2, a rectangular polishing bath tank is indicated at 5 containing an aqueous polishing bath the surface level of which is indicated at 6. A rectangular plate 7 is disposed in the tank 5 so that it is substantially upright and the lower end rests on the bottom of the tank. The polishing bath may be one wherein the polishing action occurs chemically. For example, the plate 7 may be formed of aluminum and the polishing bath may have a composition as disclosed in my U.S. Pat. Nos. 2,705,191 and 3,041,227—.

The horizontal center line of plate 7 is indicated at *c* in FIG. 2. When the plate 7 is placed on one of its long edges in the tank 5 as shown in FIG. 1, the level of the polishing bath 6 comes up to a horizontal line *x* which is appreciably above the center line *c*. In chemical polishing, the polishing action starts as soon as the plate 7 is introduced into the bath. By lifting the plate 7 at a predetermined uniform rate and/or by lowering the bath level 6 at a uniform rate (as by pumping or partial draining) the liquid level on the plate 7 is allowed to fall to the line *y* which is the same distance below the center line *c* as the line *x* is above it. When the line *y* is reached, the plate 7 is completely removed from the bath thereby promptly terminating the polishing action.

The partially polished plate 7 is then inverted and disposed in the tank 5 so that what was initially its upper long edge is now the bottom edge and resting on the bottom of the tank. The level of the polishing bath is now at line *y* and the effective bath level is dropped or lowered (preferably by raising the plate 7) at the same predetermined rate as before until the liquid level on the plate falls to the line *x* which is now on the underside of the center line *c*. The plate 7 is then removed terminating the polishing thereof.

It will be seen that the rectangular areas of the plate 7 that are above the line *x* and below the line *y* as shown in FIG. 2 will each be immersed in the polishing bath for equal times in the foregoing operation. In addition, however, all parts of the area between the lines *x* and *y* will also be subjected to the polishing action uniformly for the same amount of time as the upper and lower rectangular areas. Furthermore, it will be seen that at no time during the polishing action is the bath level on the plate 7 allowed to remain static for a prolonged period of time. The net result is that even though the plate 7 is polished in two steps, the treatment is the same over all the surfaces and no line of demarcation is either formed or remains.

Those skilled in the art will understand that the plate 7 should be polished when it is in an upright or substantially vertical position in order to permit gases that may be formed at the surfaces to rise without causing streaking.

It will also be apparent to those skilled in the art that the procedure described above in connection with FIGS. 1 and 2 may be altered in several respects. For example, the plate 7 could be first suspended above the bottom of the tank 5 so that the plate 7 extends down into the polishing bath only to the level of line *y*. Then the plate could be lowered at a uniform rate until the level of the bath reaches the line *x*. The plate would then be removed from the bath inverted and the foregoing operation repeated but starting with the plate immersed only to the depth of line *x* which will now be on the bottom of the centerline.

If it is desired to electropolish the plate 7 as distinguished from chemically polishing it, then rectangular electrodes will be installed in known manner on one or both sides of the plate

7 so as to be parallel to and coextensive with respect to the maximum areas to be polished on opposite sides of the plate. The plate 7 will be made the anode while the other electrodes will be made the cathodes. The tank 5 will have to be formed of, or lined, with, insulating material. It will be understood that any conventional electropolishing bath composition and operating conditions therefor may be used that are appropriate insofar as practicing the present invention is concerned.

A second embodiment of the invention will now be described in connection with FIGS. 3—5. In FIG. 5 a cylindrical vessel or tank is indicated generally at 10 having an end wall 11 which is completely closed and an end wall 12 at the opposite end which has a flanged central port 13. Before the ends 11 and 12 are assembled to the main cylindrical section 14 of the vessel 10, the are each polished on the interior, either by electropolishing or by chemical polishing. For purposes of illustration, the manner in which the end 11 may be electropolished on the interior will be described in connection with FIGS. 3 and 4.

The end 11 is supported on three blocks 15—15 as shown in FIG. 4 so that it is level. A narrow platform 16 is then clamped on the rim of the end 11 so that the vertical shaft 17 forming part of the electropolishing apparatus is centered with respect to the end 11. The platform 16 carries an electric motor 18 having a worm 20 on the end of the rotor shaft which engages in driving relationship a worm gear 21 carried on the upper end of the shaft 17. The foregoing arrangement corresponds to the one that is shown and described in FIGS. 1 and 2 of my U.S. Pat. No. 2,861,937.

The lower end of the shaft 17 supports a sector-shaped or pie-shaped copper mesh electrode 23 which is curved or contoured so as to conform to the radius of curvature of the interior surface of the end 11. As is well understood by those skilled in the art, when the end 11 is filled with an electropolishing bath and when the end is made the anode and the electrode 23 is made the cathode, an electropolishing action occurs as the motor 18 causes the electrode 23 to sweep at a uniform speed over the interior surface. The operating details with respect to current density, temperature, bath composition may be conventional and for no part of the present invention.

The ported end wall 12 may be polished on the interior in the same manner as the end 11 but it will be necessary to close the end of the port 13 with its cover (not shown) so as to make it liquid tight.

After the interiors of the domed or dished ends 11 and 12 have been polished, they are assembled (e.g. welded) to the ends of the cylindrical section 14. The tank or container 10 is then supported in a horizontal position on two or more pairs or sets of rollers 24 and 25 with one of the rollers 25 being arranged to be driven by an electric motor 26 in the manner described in connection with FIG. 3 in my prior U.S. Pat. No. 7,861,937. Cathode indicated generally at 36 is introduced into the vessel 10 through the port 13. The cathode 36 is formed of a main narrow cylindrical section 37 and two arcuate sector-shaped end portions 38 and 40. The main and intermediate portion 37 has a radius of curvature which corresponds to that of the cylinder wall 14 and is supported adjacent both ends by insulating rollers 41—41 secured to the outer surface and frame of the cathode 36. The upper end of the sector section 38 is electrically connected to a conductor 42. The construction and placement of the cathode 36 and its component parts correspond to the construction and placement of the cathode 36 in FIGS. 3 and 4 of my prior U.S. Pat. 2,861,937.

After the cathode 36 has been put in place, an electropolishing bath may be introduced into the vessel 10 through the line 43 the inner end of which carries a vertical section 44 the lower end of which nearly touches the lowest part of the electrode section 37 to an initial depth indicated by the horizontal broken line 45. The vessel 10 is made the anode and the polishing current is turned on so as to flow up in known manner. It will be understood that the cathode 36 hangs down in a vertical position in the manner of a free pendulum while the motor 26 rotates the vessel 10 about its horizontal axis. In this way the interior surface of the cylindrical section 14 as well as the wetted annular portion of the interior surface of the ends 11 and 12 for the initial depth of the bath 45 are subjected to a uniform polishing action. However, as soon as the current is applied with the vessel 10 being rotated, the depth of the bath is progressively lowered at a predetermined rate. This can be accomplished by means of withdrawing the bath through the line 43–44. The withdrawal rate is such that it continues at a predetermined rate until the interior surface of the cylindrical section 14 has received an adequate polishing action. The polishing current is then interrupted and the cathode 36 and the polishing bath removed from the interior.

In the foregoing operation it will be seen that while the annular portions of each end 11 and 12 (as distinguished from the center portions) receive a greater aggregate polishing action than the central portions, nevertheless, no line of demarcation is formed since the level of the bath is gradually and continually lowered so that there is no opportunity for such a line to form. When the interior of the vessel 10 is inspected after the foregoing operations have been complete, the entire inner surface will appear to have a uniform microfinish with no lines of demarcation therein.

I claim:

1. In the method of polishing an object wherein a bath of liquid is employed with the object having a vertical dimension when disposed in the bath for polishing which substantially exceeds the depth of the bath but is appreciably less than twice said depth, the steps which comprise, disposing said object into said bath so that the surface level of said bath is initially a predetermined distance either above or below the horizontal center line of said object based on said vertical dimension, initiating the polishing action, progressively shifting said surface level and said center line with respect to each other at a predetermined uniform rate and in a single direction whereby said surface level approaches, coincides with, and n moves away from said center line a distance equal to said predetermined distance, terminating said polishing action, disposing said object into said bath in the inverted position so that surface level of the bath is at said predetermined distance above or below said horizontal center line depending upon whether said surface level was above or below in step one, resuming the polishing action, progressively shifting said surface level and said centerline with respect to each other at a predetermined uniform rate and in a single direction whereby said surface level approaches, coincides with, and then moves away from said center line a distance equal to said predetermined distance, and terminating said polishing action.

2. In the method of claim 1 obtaining said progressive shifting of said surface level and said horizontal center line of said object by lifting or lowering said object.

3. In the method of claim 1 obtaining said progressive shifting of said surface level and said horizontal center line of said object by lowering or raising said surface level.

4. In the method of claim 1 obtaining said polishing action by means of a chemical polishing bath.

5. In the method of claim 1 obtaining said polishing action by electropolishing.

6. In the method of polishing the interior of a vessel having closed ends and a sidewall concentric about an axis of revolution with at least one of said closed ends having an access port the steps which comprise, first uniformly polishing the interiors of said ends, disposing said vessel for rotation about its said axis of revolution, introducing a bath of liquid for providing polishing action into said vessel to a sufficient depth to extend part way up said closed ends, rotating said vessel about said axis, initiating said polishing action, and changing the depth of said bath uniformly at a predetermined rate at least for as long as said polishing action is continued.

7. In the method of claim 6 disposing said vessel for rotation so that the bottom of said sidewall at any time during rotation is approximately level.

8. In the method of claim 6 changing the depth of said bath by increasing the same.

9. In the method of claim 6 changing the depth of said bath by decreasing the same.

10. In the method of claim 6 obtaining said polishing action by means of a chemical polishing bath.

11. In the method of claim 6 obtaining said polishing action by electropolishing.

* * * * *