

March 3, 1931.

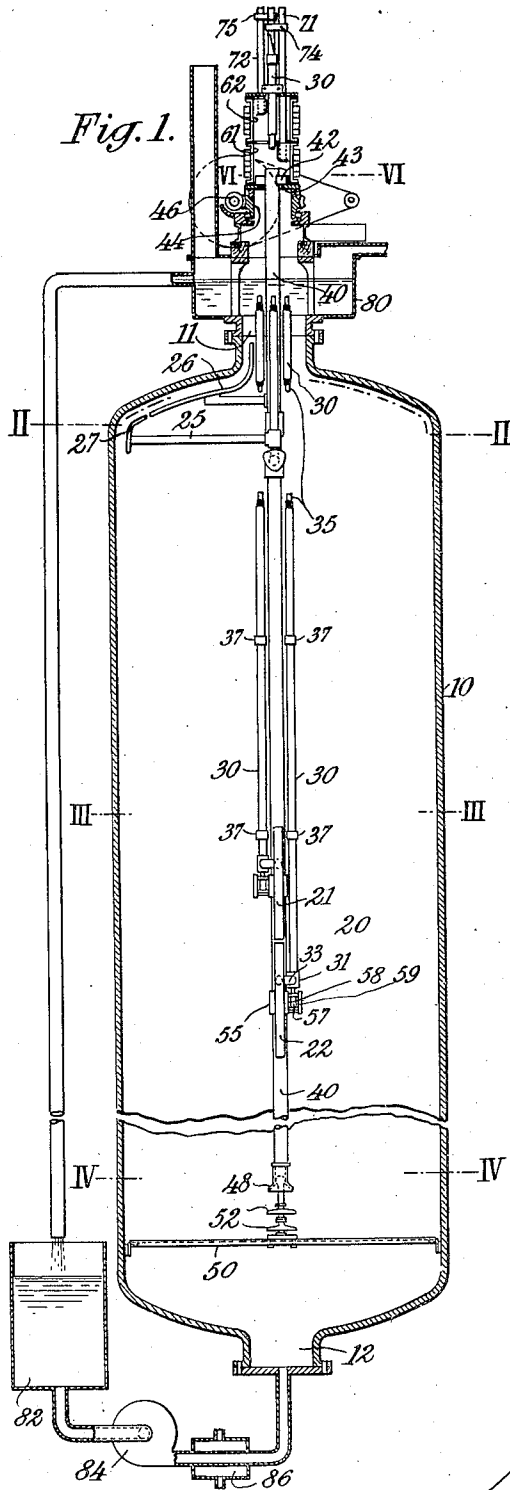
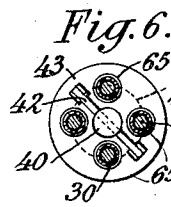
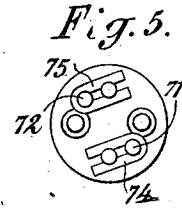
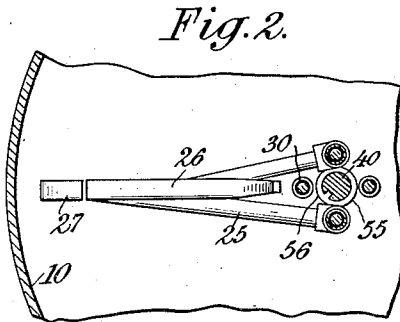
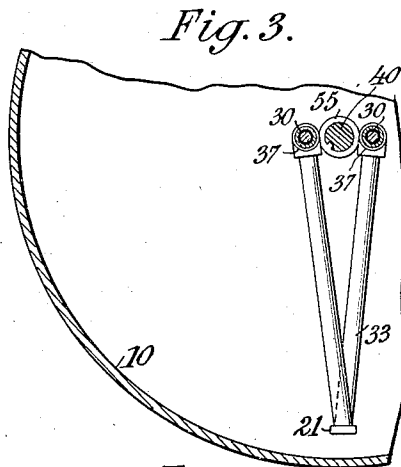
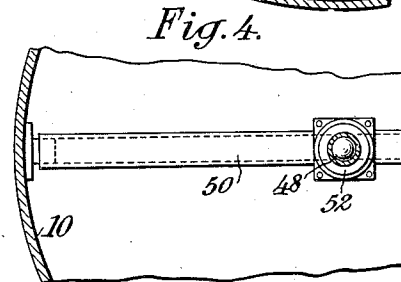
K. W. SCHWARTZ

1,794,487

PROCESS AND APPARATUS FOR ELECTROPLATING

Filed June 26, 1928

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 7.

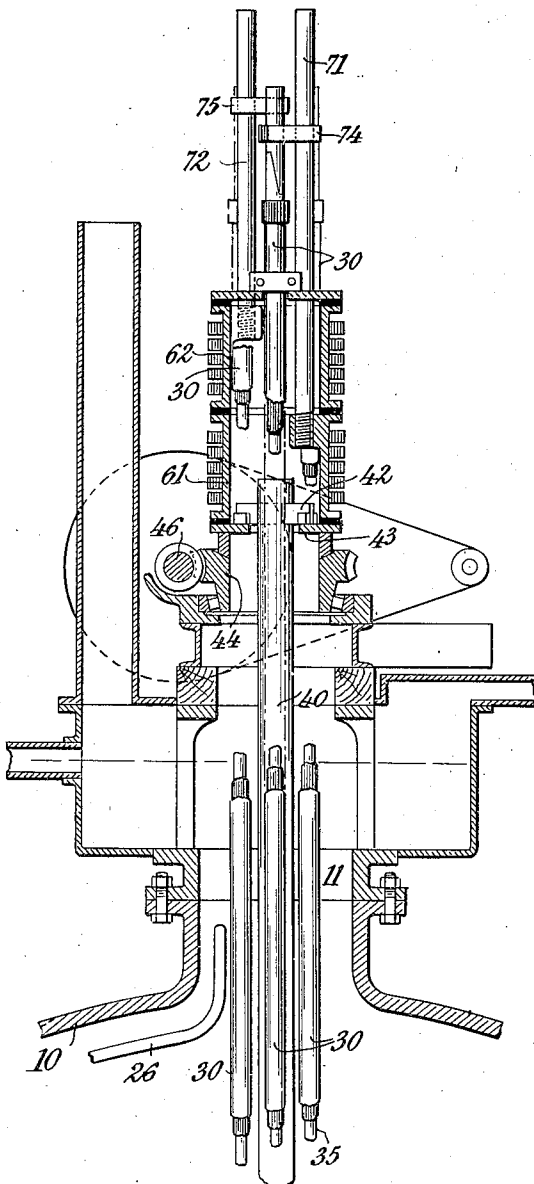


Fig. 8.

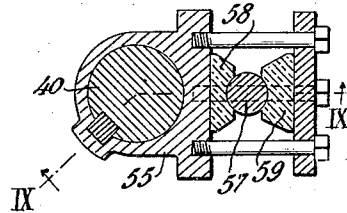
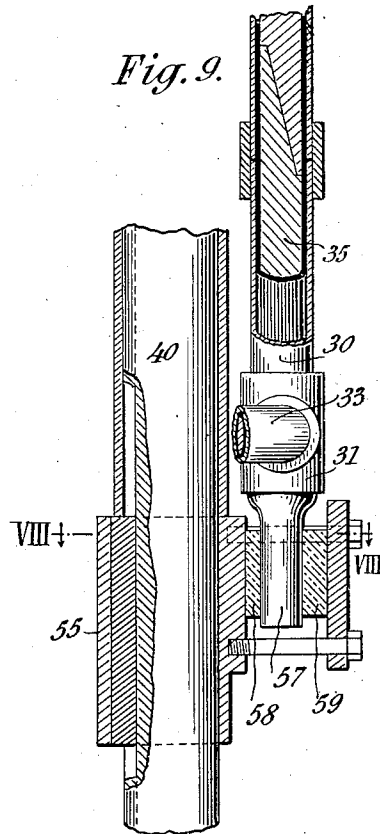


Fig. 9.



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UNITED STATES PATENT OFFICE

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PROCESS AND APPARATUS FOR ELECTROPLATING

Application filed June 28, 1928. Serial No. 288,436.

This invention relates to a process and apparatus for electroplating, and more particularly for progressively or successively plating large areas and other areas where conditions are such that progressive plating is necessary or desirable, and provides improvements therein. An invention of this general type is shown in my U. S. Patent #1,720,354, granted July 9, 1929.

10 The invention provides an improved apparatus, particularly useful for plating the inside of hollow vessels, and further provides means for current distribution to the anode structure.

15 The invention further provides an improved means and method of effecting cleaning of the surface to be plated, by hydrogen released by the electric current.

20 Other features of improvement will be set forth in connection with the accompanying description.

An embodiment of the invention is illustrated in the accompanying drawings, wherein:

25 Figure 1 is a vertical longitudinal section of a large still, such as used in oil cracking, and having set up therein and thereon the apparatus for electroplating.

30 Figs. 2, 3 and 4 are sections on the lines II—II, III—III and IV—IV, Fig. 1, respectively.

Fig. 5 is a top plan view of certain of the electrical connections shown at the extreme upper portion, Fig. 1.

35 Fig. 6 is a section on the line VI—VI, Fig. 1.

40 Figs. 7, 8 and 9 are detail views on an enlarged scale, Fig. 7 being an enlargement of the parts shown in vertical section in the upper part of Fig. 1; Figs. 8 and 9 being enlarged views showing the connection between the shaft 40 and the conduits 30 and 33 carrying the electrical conductors leading to the anodes, Fig. 8 being a cross-section on line VIII—VIII Fig. 9, and Fig. 9 being a vertical section on line IX—IX Fig. 8.

Referring to said drawings, numeral 10 designates an article to be plated, here shown as a large still or reaction chamber used in the process of cracking oil. As an example,

such stills have a height of 40 feet, and a diameter of 10 feet. These reaction chambers are usually provided with restricted openings 11, 12 at top and bottom, of a few feet in diameter. Many of these reaction chambers are set up in installations, and it is desirable to be able to electro-deposit the coating metal on the vessel 10 in situ.

The preferred coating metal is chromium. Any suitable solution for electrodepositing the chromium may be used. I prefer, however, the method and solution disclosed in Fink Patent 1,581,188, granted April 20, 1926.

In electrodepositing chromium from chromic acid baths, there is relatively large disengagement of hydrogen which is released from the cathode surface as a gas, and the current densities used are relatively large.

To attempt to electrodeposit chromium simultaneously over the entire inner surface of a vessel having the given dimensions of the vessel 10, would, under ordinary conditions, require the use of about 100,000 amperes. Generators this size would be inordinately large, and, in any event, it would in most cases be preferable to use generators of less ampere rating.

Furthermore, if it were attempted to electrodeposit chromium on the entire surface at once, the disengagement of hydrogen would be so great as, under ordinary conditions, to interfere with the deposition being successfully effected over the entire surface.

In making use of the present invention, deposition is carried out on a part of the inner surface of the vessel 10, at a time, and this electrodeposit is progressively extended over or around the entire surface.

Numeral 20 designates an anode comprising electrically-independent sections, two such sections, 21, 22, being here illustrated. 25 indicates a second anode comprising electrically-independent sections 26, 27. Additional anodes similar to 20, 25 may, if desired, be employed.

Means are provided for moving the anodes axially of the vessel, and also for rotating said anodes.

The means for moving the anodes preferably comprises a tube or the like 30, passing

into the vessel through its neck 11 and extending upwardly beyond the solution level. At the lower end of the tube 30 there is conveniently a T 31, to which is connected a hollow arm 33, the said arm 33 carrying at its outer end one of the anode sections, 22 for example. The anode sections 21, 26, and 27 are similarly connected.

The tube 30 and arm 31 preferably enclose an insulated electrical conductor 35 which carries current to one of the anode sections. The tube 30 and arm 33 therefore serve for protecting the insulation of the conductor from the electroplating solution, as well as serving for physical movement and support of the anode section. Each of the anode sections have similar conductors leading thereto, and these conductors being connected independently to each of the anode sections, and being also connected to independent collector rings, as hereinafter more fully described, enables voltages, differing one from another, to be applied at the anode sections, and thereby differing currents and current densities to be obtained between the anode sections and the cathode surface (inner surface of the vessel 10).

The tube 30 is preferably made in several longitudinal sections as shown, connected by couplings 37. As the anode sections are extended further axially down into the vessel, section after section may be added.

The means for rotating the anodes (and sections) preferably comprises a shaft 40. This shaft 40 extends into the vessel, preferably through the opening 11, and is preferably supported at its upper end by a key 42 resting against a plate 43, which latter rests upon a sleeve 44 having teeth meshing with a worm 46, by which it is driven. The weight of the shaft 40 is sustained by the plate 43 on which the key 42 passing through the said shaft 40, rests. The lower end of the shaft is preferably steadied and centered by means of a ball and socket connection 48. A temporary cross-piece 50 attached to the walls of the vessel 10 serves to support the lower part of the connection 48, and insulators 52 are provided for insulating the shaft from the vessel 10.

The shaft 40 is rotated by the worm 46 (through the sleeve 44, plate 43 and key 42, as hereinbefore explained) and this rotary motion is imparted to the anode sections through collars 55 having a key connection to the said shaft 40 as shown at 56, Fig. 2, the T 31 to which the arm 33 carrying an anode section, is connected, having an extension 57 which is fastened to the said collar 55. This extension 57 is conveniently a pin threaded into the T and clamped between insulating plates 58, 59, the said plates 58, 59 thereby insulating the anode and its supporting parts from the shaft 40 and collar 55 sliding thereon.

The collars 55, together with the shaft 40, serve as guiding means for the anode sections in their axial movements, and preserve the centered position of said sections with respect to the vessel 10. Suitable rings for collecting current which is led to the anode sections, are provided. Two of these, 61, 62, are shown. These are preferably connected to the plate 43 (being suitably insulated therefrom and insulated from each other, as shown), and turn with the said plate 43. These rings 61, 62 are hollow and permit of the tubes 30 which support the anode sections extending upwardly therethrough, the said plate 43 being provided with suitable openings 65 through which the said tubes 30 may pass. Connection between the conductors 35 leading to the anode sections 22 (and others) to the rings 61, 62 is made accessible and convenient by providing terminal extensions 71, 72 from the inside of the rings 61, 62, and the ends of the conductors 35 which project through and beyond the rings 61, 62 is made to the terminal extensions 71, 72 through heavy clamps 74, 75. These clamps 74, 75 are accessible and may be readily removed and replaced for connecting the terminal extensions to different anode sections, and also in making the changes necessary for effecting the axial displacement or movement of the anode sections.

The connection of the anode sections to independent collector rings permits of current at different strength and potential being led in through said collector rings.

An overflow basin 80 is preferably provided at the upper end of the vessel 10, which permits of the solution level being above the vessel 10. From this basin 80 the overflow passes to a tank 82, and circulation is provided by forcing the solution from vessel 82 into the bottom of the tank and causing it to overflow at the upper end from the basin 80. A pump 84 connected to the tank 82 and lower end of vessel 10 is here shown. This indicates an interchanger through which temperature regulation may be effected.

Operation

To effect plating of the vessel 10, current is led to the anode sections 21, 22 for example, through the rings 61, 62 and conductors 35. The tubes 30 which are used to move the anode sections axially, hold the anode sections in a desired plating position, here shown as in a position designated the "third position". The shaft 40 is rotated through worm 46, plate 43 and key 42, and through the key connection therewith of the collar 55 carries the anode sections 21, 22 around with the said shaft 40 as it is rotated. The current passes between the anode and the cathode and electrodeposition is effected on the cathode surface opposite the anode sections, and extends progressively around the anode (in

the axial position of the anode) as the anode is rotated. After the anode has been moved entirely around in one position yielding the required thickness of plate, it is shifted axially to another, and rotated in that position, completing another band of electrodeposit, and this is repeated until the plating of the inside surface, or so much thereof as is desired, is completed.

The anode sections 26 and 27 are preferably shaped to the underside of the top of the vessel 10. In practice, it has been found that, particularly in plating the upper top portion of the vessel 10, currents of different densities for different portions of this surface are desirable. The independent electrical connections of the sections 26, 27 permit of a flow of current from one of these sections to the cathode which is different than that which flows from the other. For example, a greater current density is passed between the anode section 27 and the opposite portion of the cathode 10 than between the anode section 26 and the part of the cathode surface opposite it.

In adjusting the axial position of the anode sections 21, 22 for example, sections of the tube 30 are removed, or added, and joined by unions 37, and the ends of the conductors 35 projecting therethrough are connected through suitable clamps 74, 75 to the terminal extensions 71, 72 connected to the collector rings 61, 62.

Method

According to my invention, I may effect cleaning of the surface by the current in conjunction with deposition. In carrying this into practice, particularly with a chromic acid plating solution, I lead current to one of the anode sections, 21 for example, at a current density which effects plating on the cathode surface opposite thereto. To the other anode section 22 I lead current at a density which is insufficient to effect a plate, but which is sufficient to release hydrogen on the cathode surface opposite thereto. This hydrogen evolution lifts particles of any foreign matter from the anode surface and also effects reduction of oxides present on the cathode surface. When the anode sections are shifted, the anode section 21 is shifted to the position formerly occupied by the anode section 22, and plating effected on the surface previously prepared by the hydrogen evolution thereon, as just explained, this hydrogen treatment and deposition being continued until the entire surface, or so much as is desired, is completed.

The invention may receive other embodiments than that herein specifically illustrated and described, and may be carried out by other modes of procedure than that herein specifically described.

What is claimed is:

1. Apparatus for plating successive portions of a large area, comprising an anode, means for moving said anode comprising tubular means extending outside of the bath, conductors in said tubular means connected to said anode, and protected from the bath by said tubular means, and means for guiding said anode structure in its movement to its different positions of use.

2. Apparatus for plating successive portions of a large area, comprising an anode, a tubular arm attached to said anode, means for moving said anode comprising tubular means extending outside of the bath and connected with said tubular arm, conductors in said tubular arms and tubular means, protected thereby from the bath solution, and connected to said anode, and means for guiding said anode structure in its movement to its different positions of use.

3. Apparatus for plating successive portions of a large area, comprising an anode, means for moving said anode comprising tubular means extending outside of the bath, conductors in said tubular means connected to said anode, and protected from the bath by said tubular means, and means for guiding said anode structure in its movement to its different positions of use, said guiding means comprising a shaft, and a sliding collar thereon.

4. Apparatus for plating successive portions of a large area, comprising an anode, means for moving said anode comprising means extending outside of the bath, conductors in said tubular means connected to said anode, and protected from the bath by said tubular means, and means for guiding said anode structure in its movement to its different positions of use, said guiding means comprising a shaft, a sliding collar thereon, a non-rotating connection between said shaft and collar, and means for rotating said shaft and thereby said collar and anode.

5. Apparatus for plating successive portions of a large area comprising an anode comprising a plurality of electrically independent sections, means for moving said anode, means for supplying current independently to said anode sections, and means for supplying current at a density to produce gassing at one portion of said area to be plated, and at a plating density at another portion of said area.

6. Apparatus for plating successive portions of a large area comprising an anode comprising a plurality of electrically independent sections, means for moving said anode, and means for supplying current at independent voltages to said sections.

7. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, and means for moving said anode to different axial posi-

tions, said last named means being rotatable with the anode.

8. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode to different axial positions, and means for guiding said anode in its movement to different axial positions, said last two named means being rotatable with said anode.

9. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode to different axial positions, and means for guiding said anode in its movement to different axial positions, said guiding means comprising a shaft, and a sliding collar thereon.

10. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode to different axial positions, means for guiding said anode in its movement to different axial positions, said guiding means comprising a shaft, a sliding collar thereon, a non-rotating connection between said shaft and collar, and means for insulating said shaft and guiding means from said anode.

11. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode to different axial positions, means for guiding said anode in its movement to different axial positions, said means comprising a shaft, a sliding collar thereon, a non-rotating connection between said shaft and collar, and means for insulating said shaft and guiding means from said anode, said means for moving said anode axially comprising tubular means connected with said collar, a tubular connection from said collar to said anode, and a conductor passing to said anode through said tubular means, collar, and tubular anode connection.

12. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode axially, said rotating means comprising a shaft and means for rotating said shaft, a driving connection between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric with said shaft, said means for moving said anode axially comprising a part extending through said tubular sleeve and connected to said anode.

13. Apparatus for plating successive portions of a large area, comprising an anode, means for rotating said anode, means for moving said anode axially, said rotating means comprising a shaft and means for rotating said shaft, a driving connection between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric

with said shaft, said means for moving said anode axially comprising a part extending through said tubular sleeve and connected to said anode, a tubular conducting ring concentric with said driving sleeve, a conductor from said ring to said anode, said conductor extending inside said ring and through said sleeve.

14. Apparatus for plating successive portions of a large area, comprising an anode having a plurality of sections, means for rotating said anode, means for moving said anode sections axially, said rotating means comprising a shaft and means for rotating said shaft, a driving connection between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric with said shaft, said means for moving said anode sections axially comprising tubular parts extending through said sleeve, and conductors leading to said anode sections passing through said tubular parts.

15. Apparatus for plating successive portions of a large area, comprising an anode having a plurality of sections, means for rotating said anode, means for moving said anode sections axially, said rotating means comprising a shaft and means for rotating said shaft, a driving connection between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric with said shaft, said means for moving said anode sections axially comprising tubular parts extending through said sleeve, and conductors leading to said anode sections passing through said tubular parts, tubular conducting rings concentric with said driving sleeve, said conductors being connected to said rings.

16. Apparatus for plating successive portions of large area, comprising an anode having a plurality of sections, means for rotating said anode, means for moving said anode sections axially, said rotating means comprising a shaft and means for rotating said shaft, driving connections between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric with said shaft, said means for moving said anode sections axially comprising tubular sectional parts extending through said sleeve alongside said shaft.

17. Apparatus for plating successive portions of large area, comprising an anode having a plurality of sections, means for rotating said anode, means for moving said anode sections axially, said rotating means comprising a shaft and means for rotating said shaft, driving connections between said anode and shaft, said means for driving said shaft comprising a tubular sleeve concentric with said shaft, said means for moving said anode sections axially comprising tubular sectional parts extending through said sleeve alongside said shaft, tubular conducting rings concentric with, and having driving connection with, said driving sleeve, terminal extensions

from said rings parallel with said tubular sectional parts, and conductors leading to said anode sections through said tubular sectional parts and connected to said terminal extensions.

5 18. A method of electroplating comprising passing current from an anode section to a portion of a cathode surface at a current density to deposit metal, and passing an independent current from another anode section to another portion of said cathode surface in the same bath at a current density to produce gassing to effect cleaning.

10 In witness whereof, I have hereunto signed my name.

15 KEVIE W. SCHWARTZ.

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