Feb. 3, 1959 A. R. HOFFMAN 2,872,544

BARREL PLATING SYSTEM

Filed Oct. 5, 1955 3 Sheets-Sheet 1

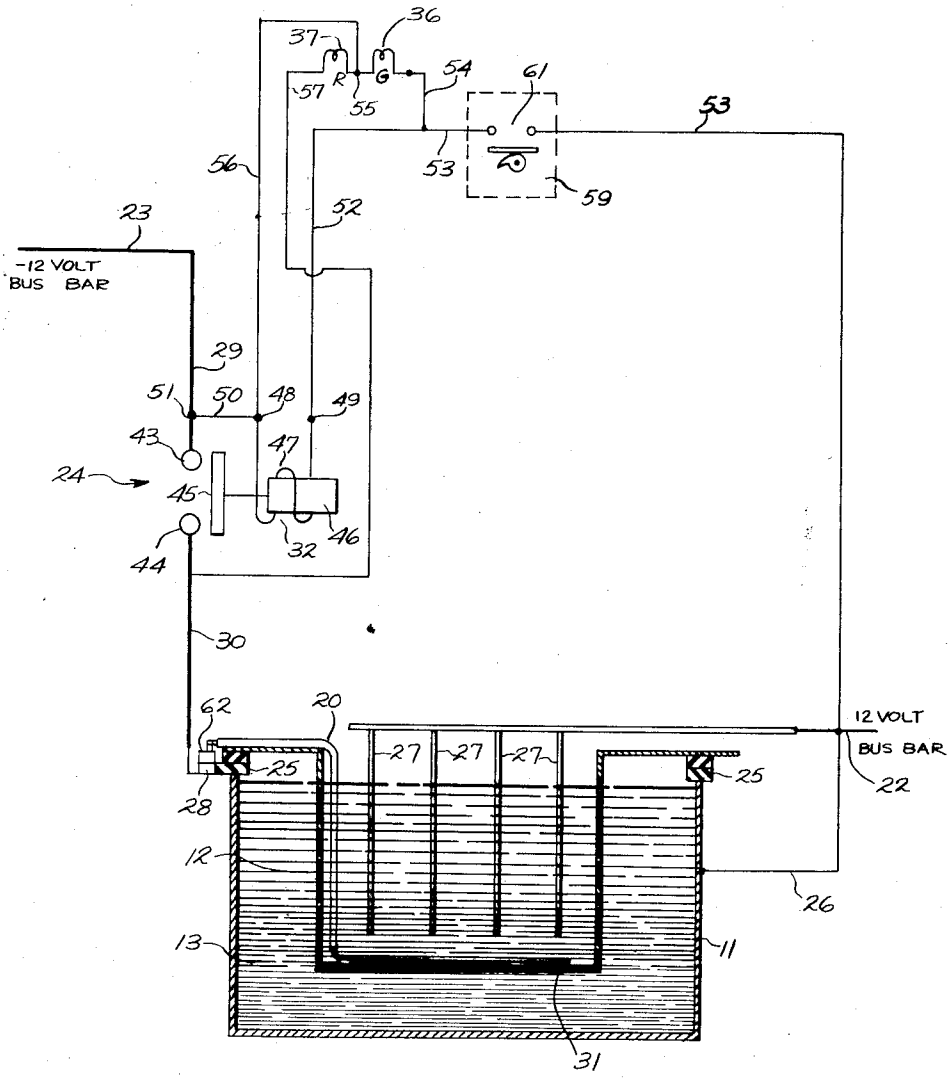


Fig. 1

INVENTOR.
AUGUST R. HOFFMAN

BY
Schramm and Knowles
ATTORNEYS

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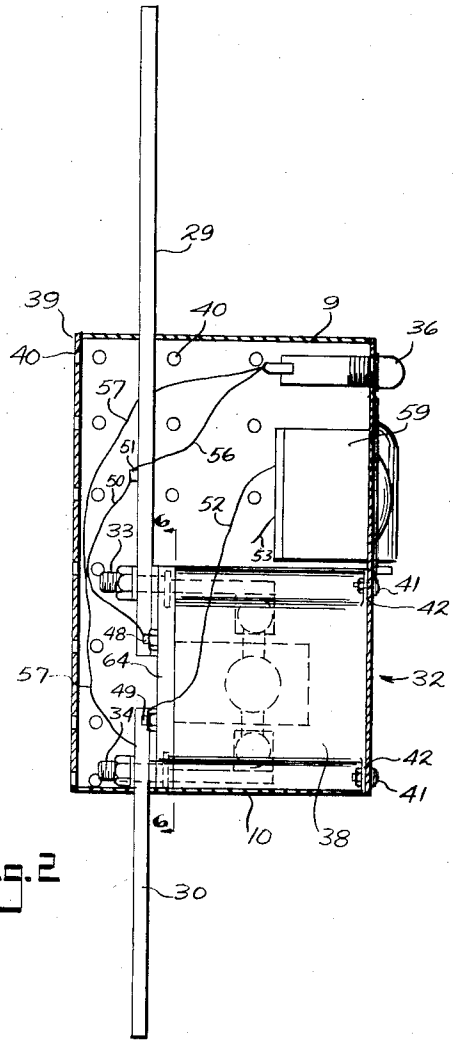


Fig. 2

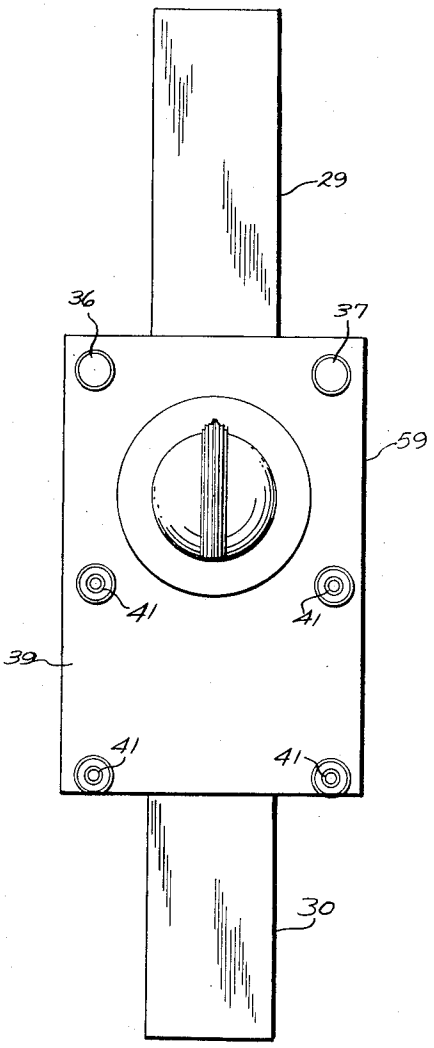


Fig. 3

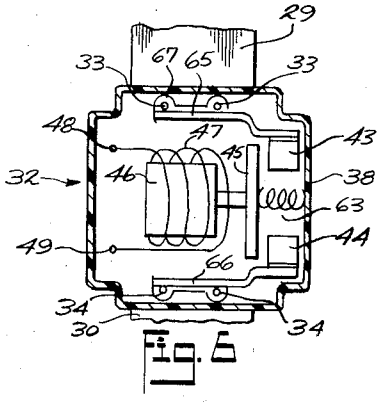


Fig. 6

INVENTOR.
AUGUST R. HOFFMAN

BY
Schramm and Knowles
ATTORNEYS

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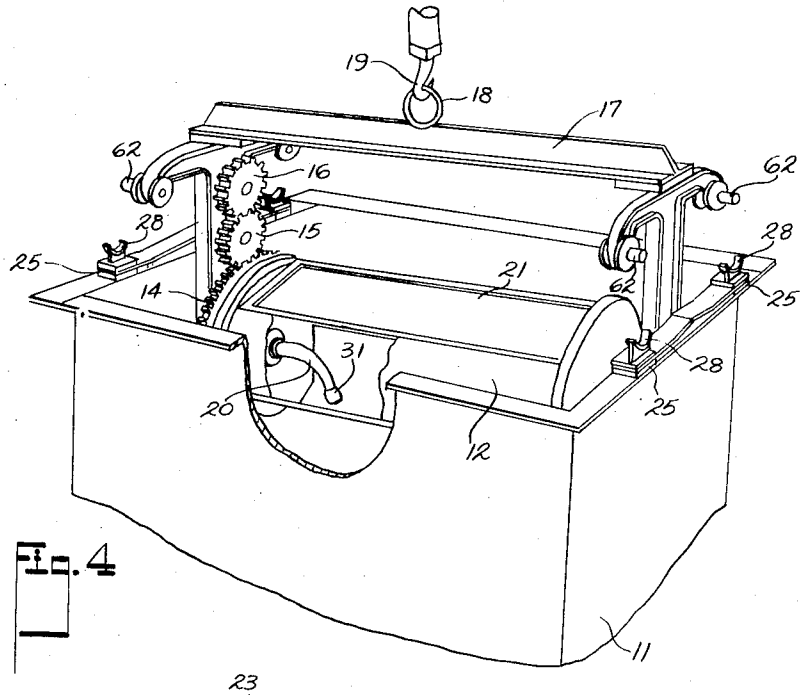


Fig. 4

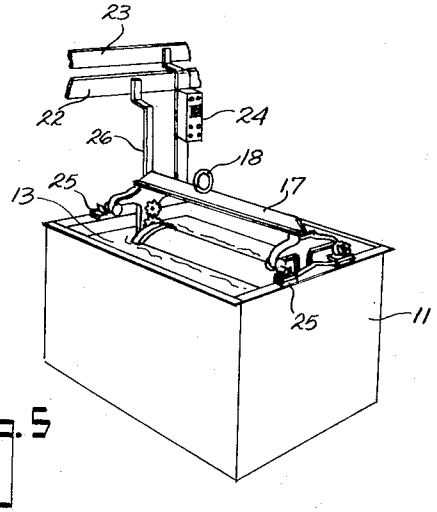


Fig. 5

INVENTOR.
AUGUST R. HOFFMAN

BY
Schramm and Knowles

ATTORNEYS

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BARREL PLATING SYSTEM

August R. Hoffman, Cleveland, Ohio

Application October 5, 1955, Serial No. 538,678
4 Claims. (Cl. 200—87)

This application is a continuation in part of my co-pending application, Serial No. 438,281, filed June 21, 1954.

My invention relates to electroplating and concerns particularly improved arrangements for barrel plating.

It is an object of my invention to accomplish safe, efficient, economical plating of articles in electroplating baths.

A specific object is to avoid excessively heavy deposits and unduly prolonged passage of electroplating current.

Another object is to avoid arcing, hydrogen explosions, splashing of electrolyte and hazard to personnel.

Still another object is to provide initiation and automatic cutoff of plating current flow in barrel plating systems to prevent flow of current except when the barrel is in place with articles to be plated fully immersed in the electrolyte.

A further object is to interrupt large currents in low voltage circuits efficiently and economically and to provide inexpensive, readily installed, durable apparatus therefor.

Other and further objects, features, and advantages of the invention will become apparent as the description proceeds.

In carrying out the invention in accordance with a preferred form thereof in barrel plating, I provide a control device interposed in one of the connections from low-voltage bus bars to the tank containing the rotatable barrel. The control device comprises a pair of plates composed of high-conductivity metal mounted in alignment with ends spaced and a contactor unit connected to the spaced plate ends. Conductor bolts support the contactor unit upon the plates. The contactor unit has a winding connected in series with the contacts of the time switch arranged to close the contacts after the barrel has been lowered into the tank to prevent arcing and splashing of the electrolyte with attendant hazard to the operator.

A better understanding of the invention will be afforded by the following detailed description considered in conjunction with the accompanying drawings in which:

Fig. 1 is a circuit diagram of an electroplating system forming an embodiment of my invention with a barrel type of electroplating tank represented schematically.

Fig. 2 is a side elevation of a control unit for the system of Fig. 1.

Fig. 3 is a front elevation of the unit shown in Fig. 2.

Fig. 4 is a perspective view of a gear-driven rotating barrel unit partially withdrawn from the plating tank of Fig. 1.

Fig. 5 is a perspective view, corresponding to Fig. 4, drawn to a smaller scale, showing the rotating barrel fully immersed and showing the control unit of Figs. 2 and 3, interposed in bus bar connections to a source of low-voltage, high-amperage plating current, and

Fig. 6 is a fragmentary view, partially in section, showing the interior of the contactor unit.

Like reference characters are utilized throughout the drawing to designate like parts.

In the barrel plating of relatively small metal articles, to coat them with cadmium, chromium or other plating metal, the articles are supported in an insulating drum provided with internal cathode connections which make electrical contact with the articles. The drum is immersed in a suitable electrolyte in a plating tank and is rotated to insure coating all surfaces of the articles and making the thickness of the coating substantially uniform.

A suitable tank **11** and drum or barrel **12** are illustrated in Figs. 4 and 5. An electrolyte **13** of suitable composition, according to the metal to be deposited, is contained in the tank **11**. The drum **12** is shown as being of the gear driven type having a ring gear **14** meshing with pinions **15** and **16** driven directly or indirectly by a motor (not shown) for rotating the barrel **12**. There is a cradle **17** rotatably supporting the drum **12** with a lifting ring **18** for receiving a crane hook **19** to enable the drum to be removed for unloading and to be immersed in the tank **11** for plating. The drum **12** is provided with openings or made in ribbed form to give free access of electrolyte to the articles in the drum. Internal cathode connections **20** are provided consisting of insulated conductor means lying loose within the drum **12** and bare only at the lower end **31** adapted to make contact at the bottom of the drum **12** with metal articles to be plated resting in the drum. A suitable removable cover **21** is provided for the drum **12**.

For supplying plating current at low voltage of the order of 12 volts, a positive bus bar **22** and a negative bus bar **23** are provided. A control unit **24** is interposed in one of the bus connections. Although the invention is not limited thereto, in the specific arrangement illustrated, the positive bus bar **22** and the anodes (not shown in Fig. 5) are connected to the tank **11** and the control unit **24** is interposed in the connections between the negative bus bar **23** and the drum **21**.

A suitable insulating mounting, including insulator blocks **25**, is provided to insulate the metallic tank **11** from the drum cradle **17**. The bus bar **22** is connected to the tank **11** by a metallic strip **26**. As shown schematically in Fig. 1, anodes **27** are also connected to the strip **26** and the bus bar **22**.

For making electrical connections to the internal cathode connections **20** in the perforated drum **12**, through the cradle **17**, one or more stationary contacts **28** are provided, insulated from the tank **11** but adapted to be connected to the negative bus bar **23** through the control unit **24** as represented schematically in Fig. 1.

As shown in Fig. 2, the control unit **24** comprises a pair of narrow plates or thick strips **29** and **30** of highly conducting metal such as aluminum or copper, bolted to a contactor unit **32** by contact-terminal bolts **33** and **34** serving both as power-current terminals and supports for the contactor unit **32**. Indicator lamps of different colors, e. g., a green lamp **36** and a red lamp **37** are provided. The unit **32** is fully encased in an insulator housing **38**. For supporting the lamps **36** and **37** and protecting the contactor unit and terminals, a sheet metal casing **39** is provided, having the shape of a hollow square prism, composed of aluminum, magnesium, or other light metal alloy, and having a plurality of ventilating holes **40** therein. The casing **39** is supported in relation to the plates **29** and **30** and the contactor unit housing **38** by machine screws **41** fastened through the front wall of the casing **39** and flanges **42** of the contactor housing **38**. The upper and lower ends of the casing **39** may be closed by plates **9** and **10** of insulating sheet material, such as a phenol-formaldehyde condensation product sold as Bakelite, slotted to receive the plates **29** and **30**.

The contactor unit 32, encased in the insulator housing 38, has internal contacts, not visible in Fig. 2, including stationary contacts 43 and 44 connected to the terminal bolts 33 and 34, and a movable contact 45 cooperating with the stationary contacts, a plunger or armature 46 mechanically connected to the movable contact and a solenoid winding 47 in magnetic relation to the plunger for closing the contacts when the winding is energized. The solenoid winding 47 as shown in Fig. 2 has a negative terminal 48 and a positive terminal 49. For electrically connecting the terminal 48 to the negative or upper plate 29, a conductor 50 and a terminal screw 51 are provided.

The positive solenoid winding terminal 49 is connected to the positive bus bar 22 through conductors 52 and 53, and to one of the filaments of the green lamp 36 by conductors 52 and 54. The filaments of the red and green lamps 36 and 37 have a common terminal 55 connected to the upper or negative plate 29 by a conductor 56. The filament of the red lamp 37 is connected at the other end to the lower or positive plate 30 by a conductor 57.

For interrupting the flow of plating current after the current has flowed for a predetermined time sufficient to produce the desired thickness of metallic coating, a time switch 59 is provided.

The time switch 59 is shown by way of illustration as a mechanical time switch or timing clock having normally open contacts 61, closed through cam action manually by turning a knob and which reopen after a predetermined length of time for which the timer was set. The normally open contacts 61 are interposed in the conductor 53 in the line between the solenoid terminal 49 and the positive line 22 of the plating current source.

The method of electroplating described and the apparatus illustrated promote safety and economy of operation. Arcing, hydrogen explosions and splashing of electrolyte upon attendants are prevented because the electrical circuit is kept open until the barrel 12 is fully immersed in the electrolyte 13, and is reopened before the barrel 12 need be lifted.

The articles to be plated are loaded into the barrel 12 with the cover 21 removed while the cradle 17 is supported outside the tank 11 by the crane hook 19. Then, after the cover 21 has been replaced, the cradle 17 is lowered in place with the rotating drum 12 immersed in the electrolyte 13 in the position shown in Fig. 5. The action of lowering the cradle 17 causes a connection to be made through a cradle contact 62 and the stationary contact 28 between the internal cathode connections 20 and the control unit plate 30. The time switch 59 is then closed, having been preset for a timed termination intended to give the desired thickness of plating. After energization of the time switch 59, the solenoid winding 47 is energized, causing the contactor 32 to close, closing the plating circuit only after the barrel 12 has been immersed in the electrolyte 13.

When the time switch 59 has operated for the predetermined period, its contacts 61 are opened, de-energizing the solenoid winding 47 and causing the plating circuit to be interrupted. So long as the solenoid winding 47 is energized the green lamp 36 connected in multiple therewith is bright, showing that plating is going on. However, as soon as the solenoid 47 has been de-energized and the contactor opened, the red lamp 37 is energized, informing the operator that the desired thickness of plating has been produced so that the cradle 17 may again be safely lifted preparatory to recharging the drum 12. The automatic interruption of the plating current effects a saving of the anode metal by avoiding the deposit of excessive metal. It is advantageous also in producing uniformity of the plated articles in successive plating batches. Since the circuit is open when the cradle 17 is lifted, there is no arcing at the surface of the electrolyte 13 as the cradle is lifted, and no hydrogen explosions

can result. Consequently splashing of the electrolyte is avoided, and there is no hazard to the operators from splashing of electrolyte.

The arrangement is especially advantageous when plating relatively expensive metals. For example, in plating of cadmium 650 ampere-minutes of electricity represents a consumption of .72 ounce. At a price of $1.75 per ounce of cadmium, there is a loss of $1.75 for each approximately twenty minutes that the barrel is left in the solution by the operator with the current flowing, unless the automatic current interrupting arrangement of my invention is employed to prevent excessive plating. Even though the barrel should be left in the solution after the current is turned off no harm is done as the work is actually benefitted by being cleaned and actually having the surface polished or burnished thereby.

In the contactor unit 32 as shown in Figs. 2 and 6, the movable contact 45 with the armature 46 moves horizontally, transversely to the edges of the plates 29 and 30 but parallel to the faces of the plates 29 and 30. The movement of the contact 45 and armature 46 are therefore independent of gravity and controlled entirely by the solenoid 47 and a schematically represented biasing spring 63. The insulating base 64 of the contactor housing 38 serves as an end spacer for the plates 29 and 30, which are securely maintained spaced and in alignment by the pairs of bolts 33 and 34, serving both as structural supporting members and electrical conductors. Thus a simple, compact, rigid, light weight current control unit for large currents is provided, achieving maximum utility with a minimum number of separate parts.

The contacts 43 and 44 are of heavy bar stock welded to copper brackets 65 and 66 with ears 67, through which the contact bolts 33 and 34 pass. All parts are rigidly secured, and all the vibration forces transverse to the plane of the plates 29 and 30, or in the direction of their thin dimensions, are avoided.

I have herein shown and particularly described certain embodiments of my invention and certain methods of operation embraced therein for the purpose of explaining its principle of operation and showing its application but it will be obvious to those skilled in the art that many modifications and variations are possible and I aim, therefore, to cover all such modifications and variations as fall within the scope of my invention which is defined in the appended claims.

What I claim and desire to secure by Letters Patent of the United States is:

1. A heavy-current switching unit adapted to be connected in series with the cathode lead from an electroplating tank and the low potential side of a source of direct current to control the flow of plating current through the tank, said unit comprising in combination a pair of plates composed of high conductivity metal mounted in alignment and in spaced relation to each other end to end, with faces coplanar, and edges aligned, and an encased contactor unit having an insulating housing with an insulating base with protruding pairs of spaced connection bolts, one pair of connection bolts secured to one of said plates and the other pair of connection bolts secured to the other of said plates for maintaining the plates rigidly in alignment and supporting the contactor unit from the plates, the contactor unit having brackets each electrically and mechanically secured to one of said pairs of connection bolts and having fixed contacts on said bracket, and a solenoid actuated movable contact mounted within said insulated housing in operative relation to the fixed contacts, movable in a direction parallel to the faces of said plates but perpendicular to the edges thereof.

2. A heavy-current switching unit adapted to be connected in series with the cathode lead from an electroplating tank and the low potential side of a source of direct current to control the flow of plating current through the tank, said unit comprising in combination a pair of vertically extending plates of substantially greater

length than width and greater width than thickness, with vertical edges and vertical faces, said plates being in alignment end-to-end with adjacent ends spaced, and an encased contact-making unit having an insulating housing with an insulating base having two pairs of horizontally extending connection bolts extending therethrough, one pair of connection bolts lying in a horizontal plane and being secured to the lower end of one of said plates and the other pair of connection bolts lying in a second horizontal plane below the first and being secured to the upper end of the second plate, said housing containing two contact brackets each secured to one of said pairs of connection bolts making electrical contact therewith and carrying at one end thereof a fixed contact, one contact being above the other and the contacts having vertical contact surfaces lying in the same vertical plane, and a horizontally moving contact in said housing in operative relation to the contact surfaces of said fixed contacts and having its direction of motion parallel to the planes of said connection bolts and the plate face, perpendicular to the edges of said plate face, whereby vibration forces transverse to the faces of said plates and against the minimum dimension thereof are avoided.

3. A heavy-current switching unit adapted to be connected in series with the cathode lead from an electroplating tank and the low potential side of a source of direct current to control the flow of plating current through the tank, said unit comprising in combination a pair of thin plates composed of high conductivity metal mounted end to end in spaced relation to each other, with adjacent ends longitudinally spaced, and a contact making unit having an insulating base with connection bolts electrically and mechanically connected to said conductive plates, first and second contact brackets secured by said connection bolts, each bracket being electrically and mechanically connected to one of said conductive plates and

carrying a fixed contact, the contact surfaces lying in the same plane, said plane being perpendicular to the plane of said conductive plates and extending in the direction of the length of said plates, and a contact movable perpendicular to said plane for cooperation with said fixed contact surfaces, whereby vibration forces perpendicular to the plane and the smallest dimension of said conductive plates are avoided.

4. A heavy-current switching unit adapted to be connected in series with the cathode lead from an electroplating tank and the low potential side of a source of direct current to control the flow of plating current through the tank, said unit comprising first and second generally rectangular plates extending in the same direction in alignment with adjacent ends spaced, and a housed electromagnetic switch comprising an insulating base, first and second connection bolts, and contacts connected electrically to said connection bolts, said connection bolts extending through said base and each through one of said plates and electrically connected to it for maintaining the plates in alignment and supporting the electromagnetic switch from said plates while connecting said contacts to said plates.

References Cited in the file of this patent

UNITED STATES PATENTS

1,001,313	Sheehy	Aug. 22, 1911
1,148,272	Aderer	July 27, 1915
1,951,028	Lux	Mar. 13, 1934
2,070,343	Turnock	Feb. 9, 1937
2,206,908	Lunt	July 9, 1940
2,304,124	Sampsel	Dec. 8, 1942
2,370,621	Freitag	Mar. 6, 1945
2,437,620	Speer	Mar. 9, 1948
2,468,852	Wallace	May 3, 1949
2,498,128	Lang	Feb. 21, 1950