Jan. 6, 1953 G. DUBPERNELL ET AL 2,624,728

ELECTROPLATING BARREL

Filed July 14, 1949 5 Sheets-Sheet 1

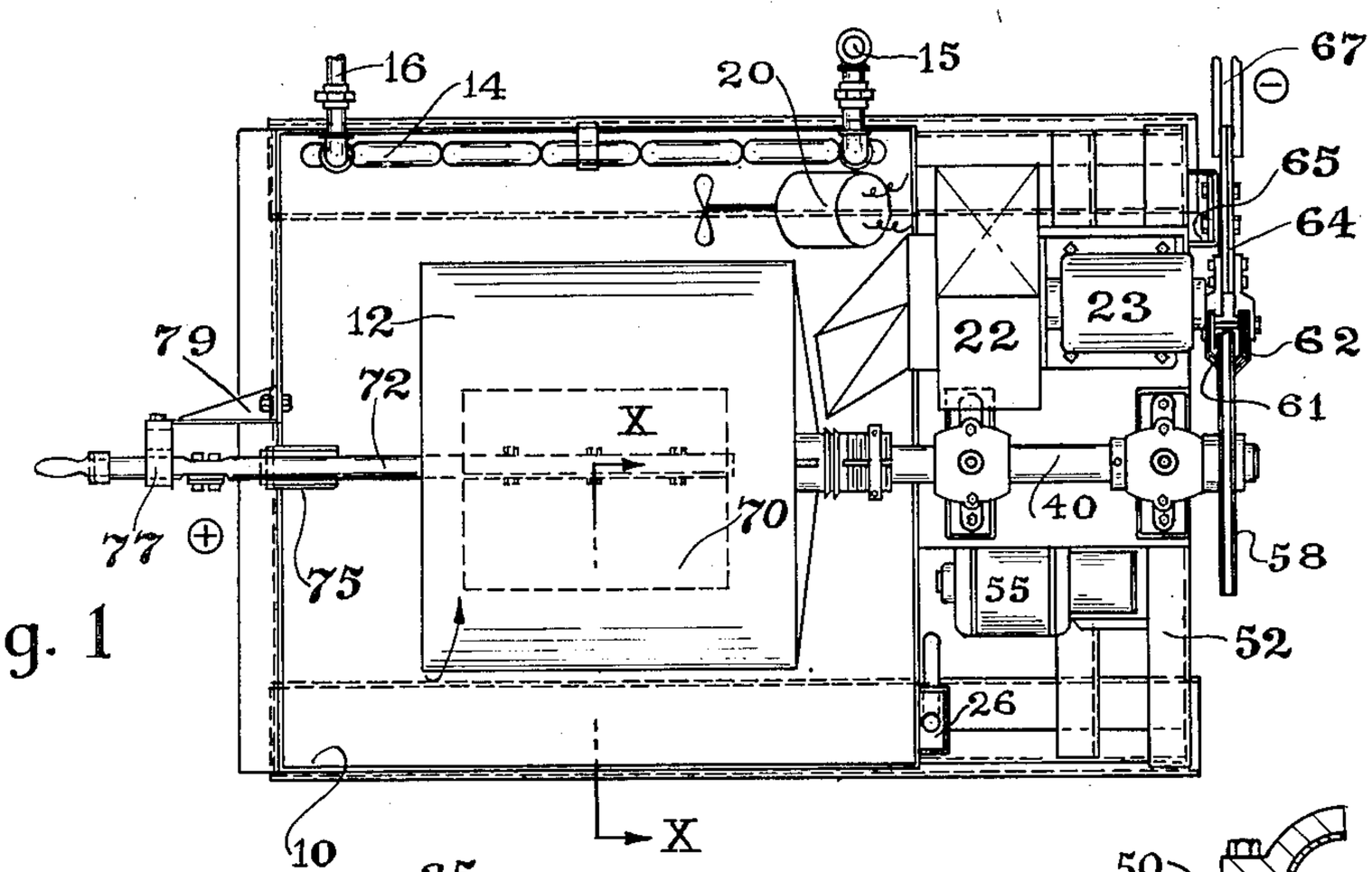

Fig. 1

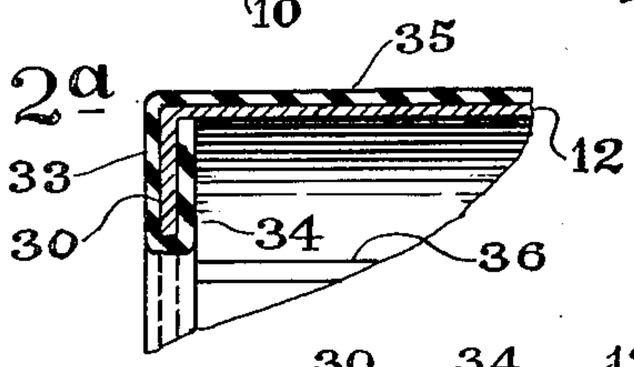

Fig. 2a

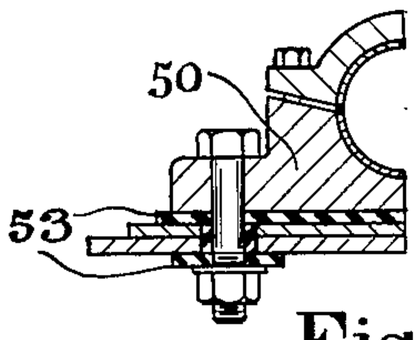

Fig. 7

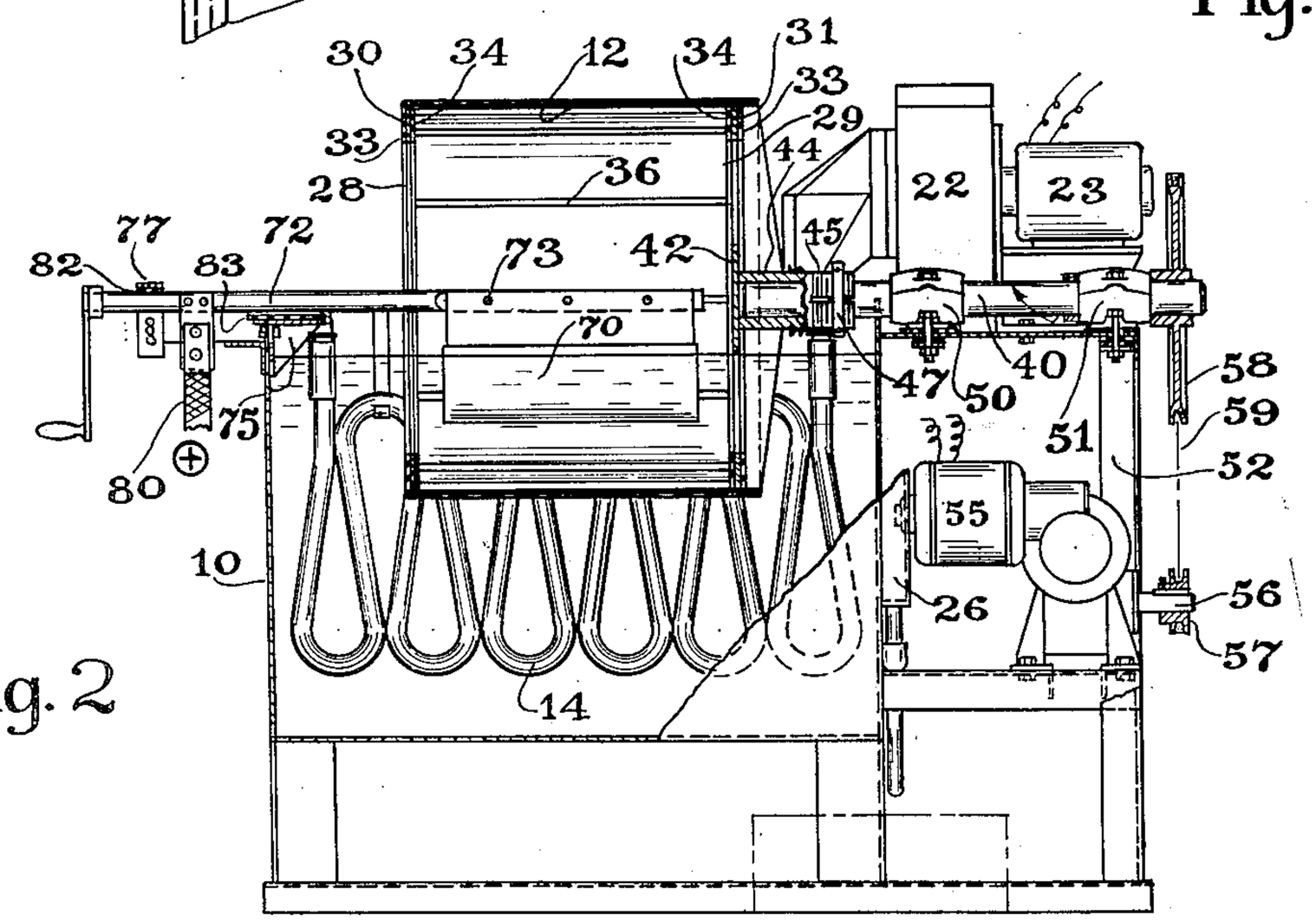

Fig. 2

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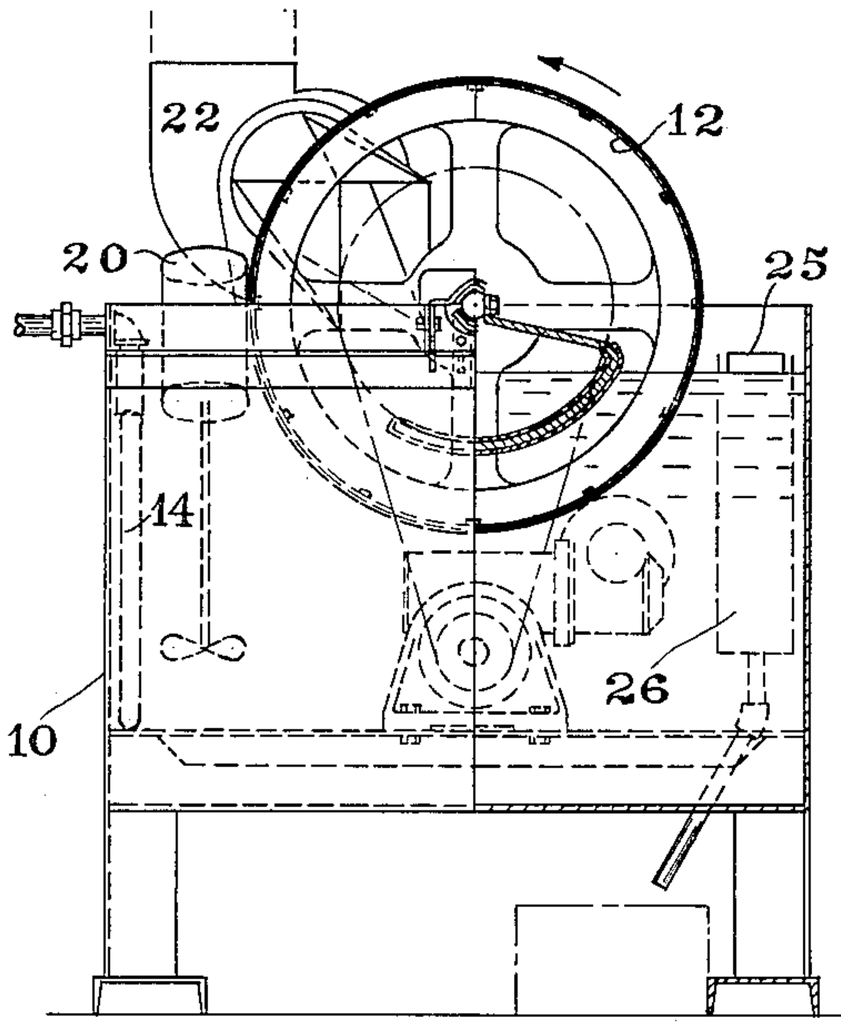

Fig. 3

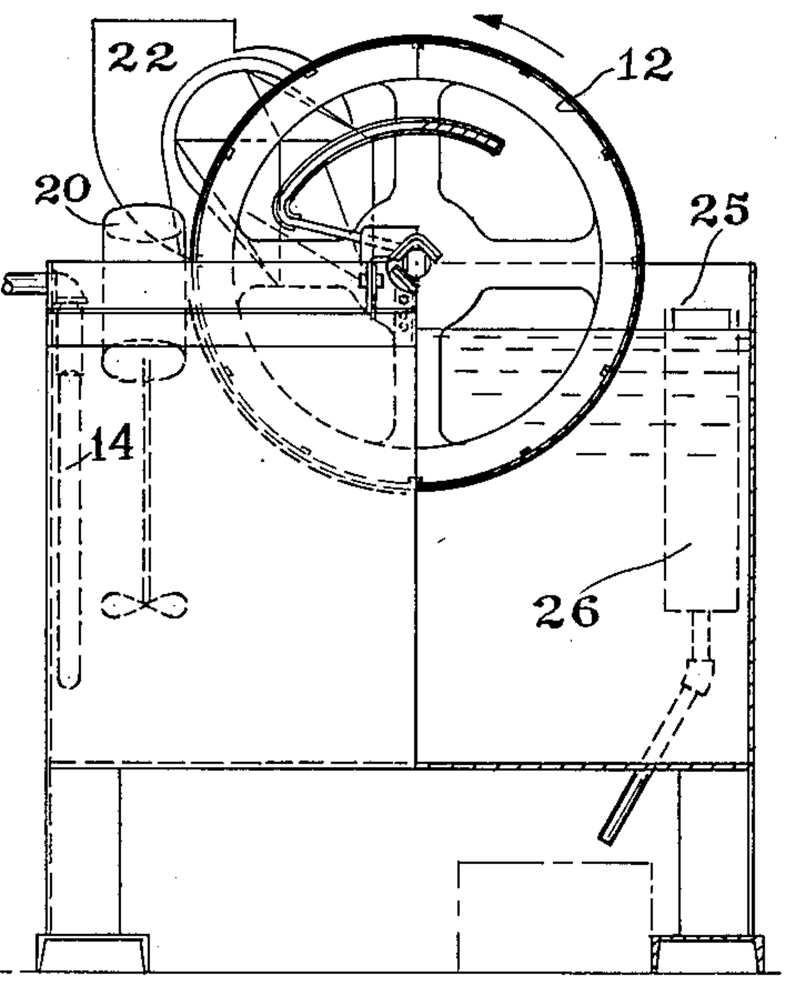

Fig. 4

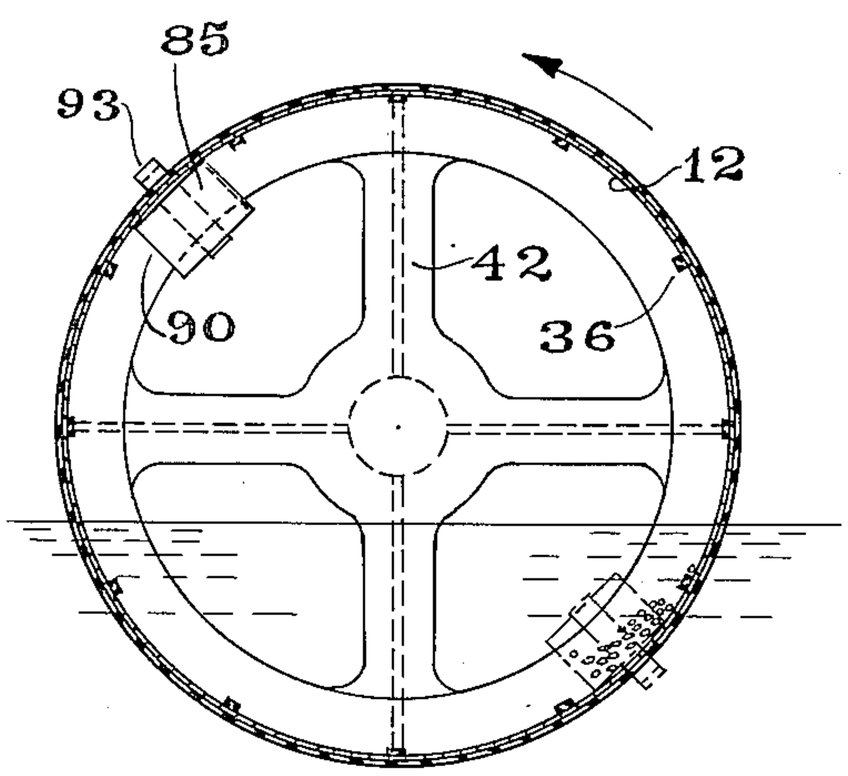

Fig. 5

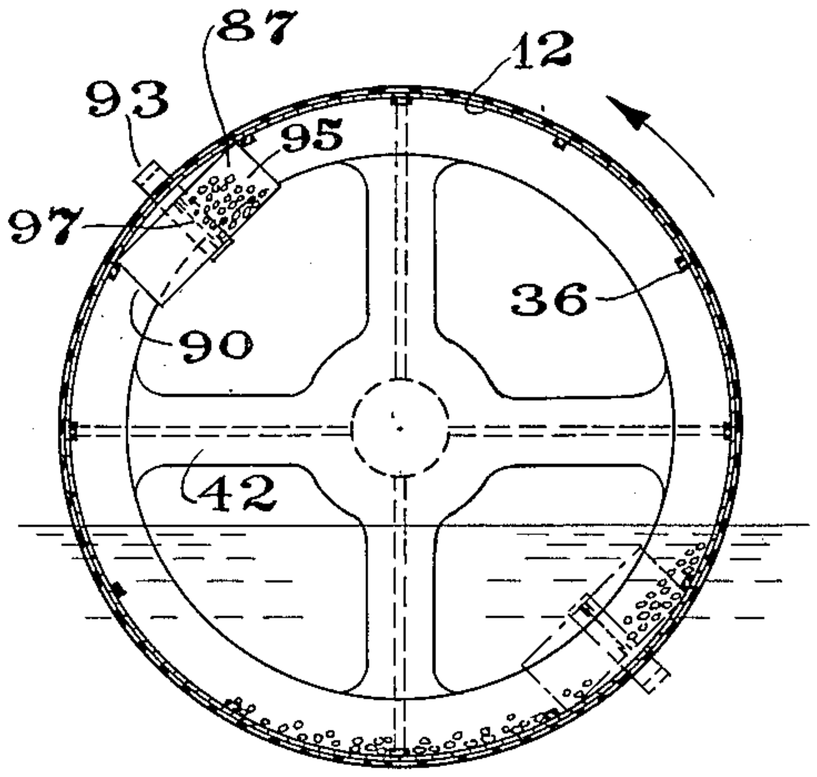

Fig. 6

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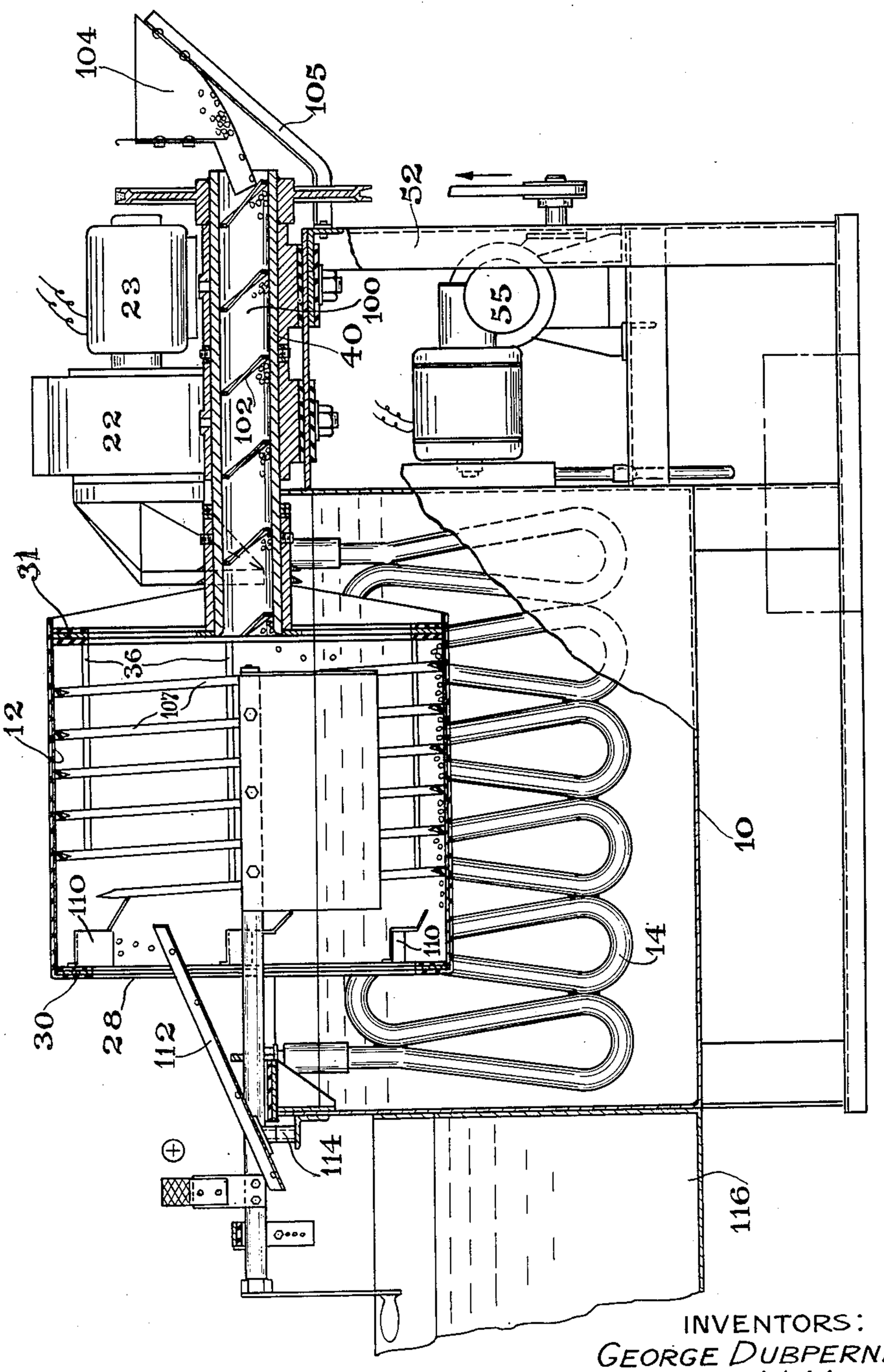

Fig. 8

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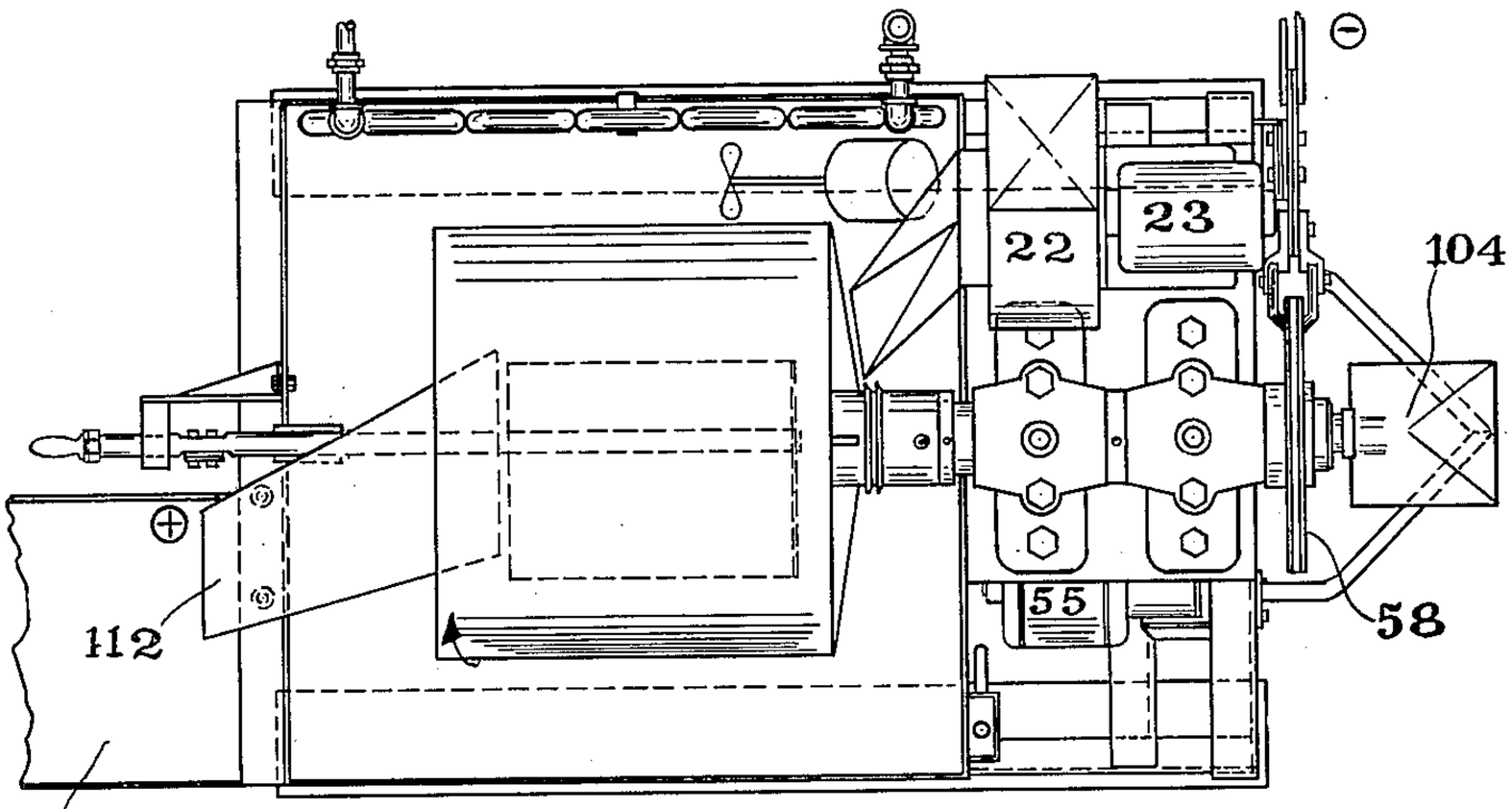

Fig. 9

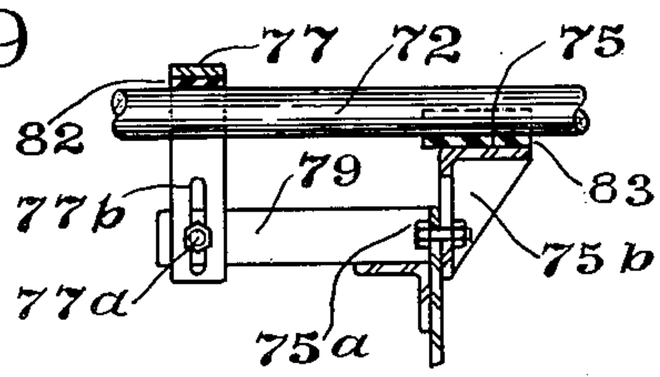

Fig. 12

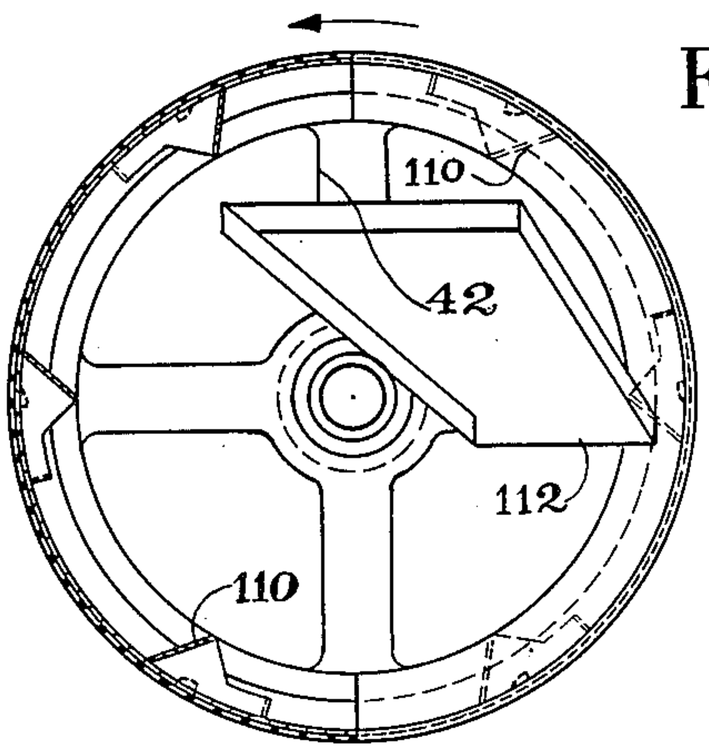

Fig. 10

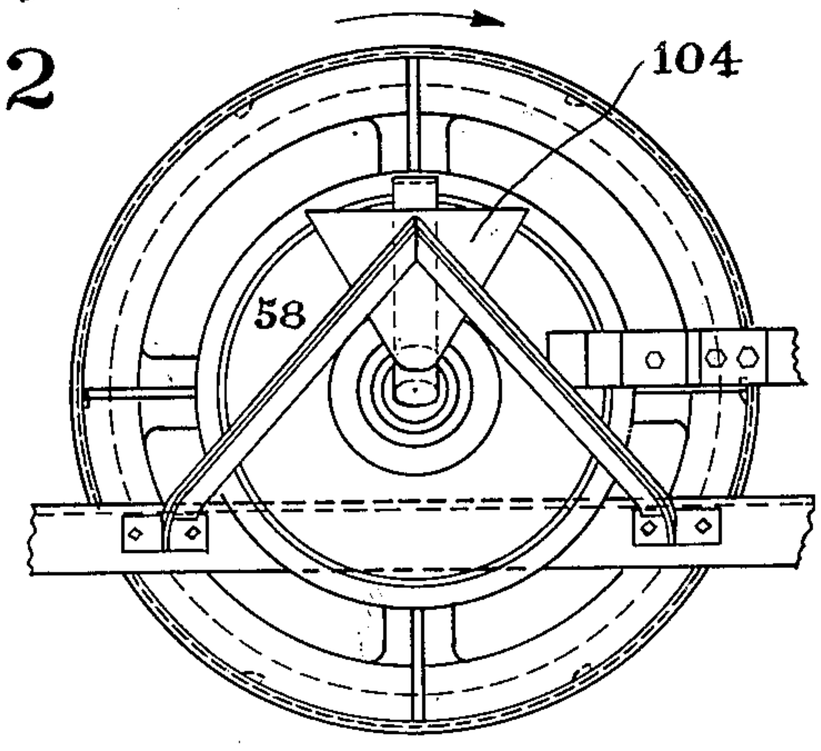

Fig. 11

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ELECTROPLATING BARREL

Filed July 14, 1949 5 Sheets-Sheet 5

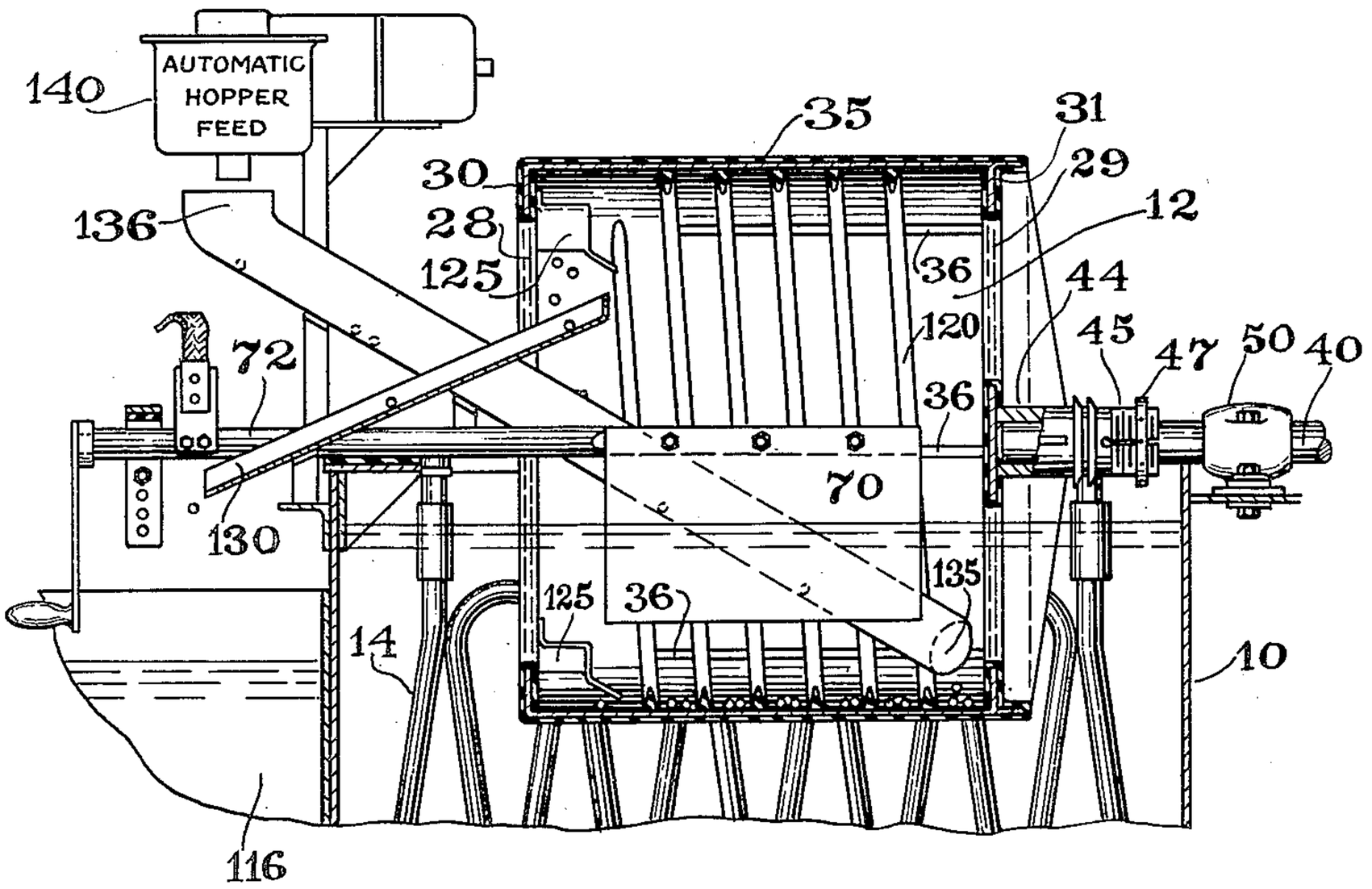

Fig. 13

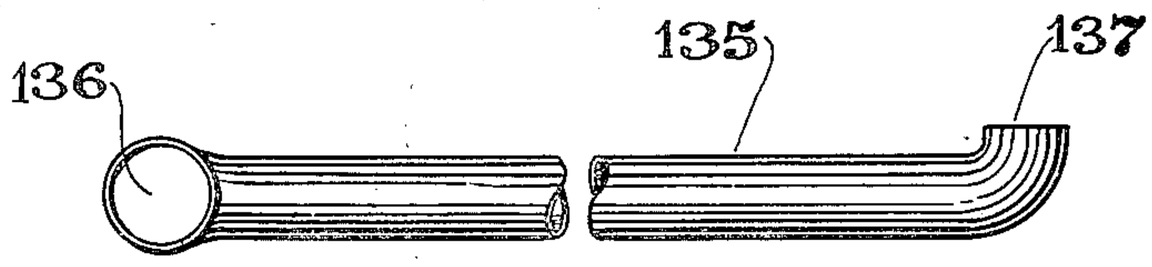

Fig. 14

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2,624,728

UNITED STATES PATENT OFFICE

2,624,728

ELECTROPLATING BARREL

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Application July 14, 1949, Serial No. 104,757

1 Claim. (Cl. 204—213)

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This invention relates to electroplating barrels, particularly for use in electrodepositing metals which are difficult to plate.

Chromium has been a metal which has presented difficulties to electroplating in barrels. Good electrical contacts, anode design and spacing, and speed of rotation of the barrel are important. Hygroscopic and corrosive constituents of the plating solution make it important to avoid fouling and corrosion of bearings and electrical connections, especially sliding connections. It is also important to remove the anode from the plating solution when current is not flowing. The feeding and removal of articles from the barrel without removal of the barrel cylinder from the plating solution has been troublesome.

The present invention provides an electroplating barrel well adapted for electrodepositing difficult metals such as chromium, which is sturdy and mechanically simple, and in which good electrical and bearings performances are obtained. The anode support construction provides for ready disassembly of the anode from the barrel, ready substitution of anodes, ready adjustment of anode to cathode spacing and ready removal of the anode from the solution without disassembly. The invention also provides novel and useful means for, and constructional adaptation to, feeding and removal of articles to and from the barrel cylinder.

Three embodiments of the invention are illustrated in the accompanying drawings, wherein

Figure 1 is a top plan view of one embodiment;

Figure 2 is a vertical sectional view of the construction shown in Figure 1;

Figure 2*a* is a detail sectional view of one corner of the barrel cylinder, showing the insulation;

Figures 3 and 4 are end elevations, partly in section on line X—X, Fig. 1, Fig. 3 showing the anode in the solution and Fig. 4 showing the anode rotated on its support out of the solution;

Figure 5 is a transverse section through the barrel cylinder showing scoops for removing plated articles from the barrel cylinder;

Figure 6 is a view similar to Fig. 5 and showing the scoops for depositing and removing articles from the barrel cylinder;

Figure 7 is a sectional detail view of a bearing for the barrel cylinder;

Figure 8 is a view mainly in vertical section illustrating a second embodiment and incorporating means for continuously feeding and removing articles from the barrel cylinder;

Figure 9 is a top plan view of the construction illustrated in Fig. 8;

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Figure 10 is an end elevation of the barrel cylinder, partly in transverse section, at the delivery end of the cylinder;

Figure 11 is a view in end elevation of the barrel cylinder at the feeding end thereof;

Figure 12 is a detail view showing a means for adjusting the height of the anode supports **75** and **77** and thereby adjusting the spacing between the anode and the work resting on the inside of the barrel cylinder;

Figure 13 is a partial vertical sectional view of a third embodiment of the invention;

Figure 14 is a plan view of the feed chute seen in Figure 13.

Referring to said drawings, numeral **10** designates a suitable tank for containing an electroplating solution and numeral **12** designates a cylindrical barrel rotatable on a horizontal axis, and circumferentially continuous, as shown. Numeral **14** designates a means for controlling the temperature of the electroplating solution in the tank, such as commonly employed, and as here shown, consists of a coil of pipe immersed in the solution and having an inlet **15** and an outlet **16** for a cooling or heating medium such as water or steam. Means for stirring the solution may be provided, as indicated by numeral **20**. Spray and fumes above the level of the solution in the tank may be drawn away, as usual, by any suitable form of means, as the fan **22** driven by motor **23**. The level of the solution in the tank may be controlled by an opening **25** in one of the walls of the tank, and a down-spout **26** which leads to a suitable overflow receptacle.

The barrel cylinder **12** is made of a suitable electrical conducting material as steel and is open at both ends to the solution in the tank, as indicated at **28, 29**. The electroplating solution may circulate through the barrel, through the end openings. Flanges **30, 31** are provided at the two ends of the barrel cylinder to prevent work being electroplated falling out. Articles being electroplated in the barrel cylinder rest in electrical contact with the inner cylindrical metal surface of the barrel cylinder. That is, the inner cylindrical surface is base metal. The flanges **30, 31** are faced with or formed of insulating material as indicated at **33, 34** to prevent these parts from diverting electric current from the work to be plated. The interior of the barrel cylinder is provided with a plurality of longitudinal ribs **36** preferably of insulating material to effect periodic tumbling of articles within the cylinder, as the cylinder rotates.

With electroplating barrels in which articles

to be plated rest (with periodic tumbling) in electrical contact with the inner metal surface of the plating barrel, it is a difficult matter (particularly with plating solutions such as the chromic acid type of chromium plating solution) to obtain full coverage and uniformly appearing plate on work to be electroplated. The difficulty of plating is also affected by the type of work to be electroplated, that is, by size, height, flatness etc. of the work. It has been found to be important in overcoming these plating difficulties to avoid diversion of the current between the anode and the work on the inner surface of the plating cylinder, and also to provide for adjustment of the spacing between the anode and the inner surface of the plating cylinder, i. e., between the anode and work in contact with the inner surface of the plating cylinder, as described later on.

For preventing diversion of plating current from the work it has been found to be important to insulate all parts of the plating cylinder except its inner cylindrical surface. In addition to the insulation **33**, **34** on the flanges **30**, the outer surface of the metal cylinder **12** is insulated, as indicated at **35**, Fig. 2*a*.

The barrel cylinder is rotatably supported at one end only, above the level of the plating solution in the tank, as shown, so that only a portion of the circumference of the barrel cylinder is submerged as it rotates. The rotatable support for the barrel cylinder is a shaft **40** attached to the cylinder at its axis, by any suitable means, as a spider **42** and a hub **44** having a split, tapered, threaded end **45**. The end of shaft **40** projects into the hub **44** and is clamped inside the hub by means of a nut **47** which nut forces the split end of the hub into binding electrical contact with the shaft as it is screwed on to the threaded, tapered end of the hub. The shaft **40** is supported in bearings **50**, **51**, which may be fastened on to a frame **52** attached to the tank **10**. As the tank and frame are usually of metal, the bearings **50**, **51** are insulated from the frame, as indicated at **53**, Fig. 7, to the end that the barrel cylinder **12** and shaft **40** are insulated from other parts of the mechanism. The shaft **40** and barrel cylinder **12** mounted thereon is rotated at a suitable speed by a suitable mechanism, such as an electric motor reduction-gear unit **55**, having an output shaft **56**. Mounted on the shaft **56** is a pulley **57** and this drives a pulley **58** fastened on the shaft **40** through a non-conducting chain or belt **59**.

Means are provided for connecting the barrel cylinder in an electric circuit as a cathode, and these means are arranged remote from the solution in the tank and fumes or spray arising therefrom, so as to thereby protect the electric contacts from fouling and causing resistance to the flow of the current. To this end, the remote end of the shaft **40** may be provided with an electrical conducting disk, which, as shown, may be integral with pulley **58**. Brushes **61**, **62** are provided, and these bear on opposite sides of the pulley **58** so as to have sliding contact therewith. The brushes are carried by a brush holder **64** attached to an insulated bracket **65** carried by the frame **52**, and the brush holder **64** is connected with the cathode bus bar **67**.

Numeral **70** designates the anode, and this is carried by a shaft **72** which projects through the open end **28** of the barrel cylinder opposite end **29** at which the barrel cylinder is supported, into the interior of the cylinder. The anode **70** is removably attached to the shaft as by means of screws or bolts **73** to permit the substitution of

anodes of different shape and diametrical projection for best performance with different types of articles to be electroplated. The shaft **72**, carrying the anode, is supported by means which function to permit the anode to be removed from the plating solution by a rotation of shaft **72**, and which also permits the ready removal of the shaft and anode from the barrel cylinder and tank. To this end, the shaft **72** has a cantilever support in a crotch type bearing **75** which opens upwardly, and a hook type bearing **77** which opens downwardly. The crotch type bearing **75** may be, as shown, supported on the upper side of the tank, and the hook type bearing **77** may be arranged on an arm **79** attached to and projecting outwardly from the side of tank **10**. The anode is electrically connected in a circuit by suitable means, as a flexible conductor **80** electrically connected to the shaft **72**. The shaft **72** is insulated from the tank by suitable insulation as indicated at **82**, **83**. The height of the anode bearings **75** and **77** is adjustable. A suitable construction is illustrated in Fig. 12. As there shown, a bolt **75***a* passes through a hole in the side of the tank and through a slot or series of holes in a bracket **75***b* which carries the bearing **75**, and by loosening and tightening the bolt **75***a*, or nut thereon, the height of the bearing **75** may be adjusted and fastened in adjusted position to thereby obtain an optimum spacing of the anode **70** from the work on the inside of barrel cylinder **12**. Likewise, a bolt **77***a* passes through a hole in bracket **79** and through a slot or series of holes in a part **77***b* of bearing **77**. By loosening and tightening the bolt **77***a*, or a nut thereon, the height of bearing **77** may be adjusted and fastened in adjusted position (along with the adjusted position of bearing **75**) to obtain the aforesaid optimum spacing of the anode **70** from the work resting on cylinder **12**. Work like thin washers require a different spacing of the anode from the bottom of the cylinder from the spacing for studs, for example, for good evenly appearing, fully covering plating. For work of different sizes and shapes adjustment of the anode spacing is also necessary for good plating results.

Work may be introduced and removed from the cylinder by hand or trough via the open end of the electroplating barrel cylinder **12**. For advantageously removing, or removing and supplying articles, from the interior of the electroplating barrel cylinder **12**, a demountable trough **85**, as illustrated in Fig. 5, or a double trough **87**, as illustrated in Fig. 6, may be provided. The trough extends from side to side across the interior of the cylinder **12** and bears closely against the interior surface of the cylinder and has an open side **90** in the direction of the rotation of the cylinder. The trough **85** or **87** is fastened against the interior of the barrel cylinder by spring strips **93** which are fastened to the ends of the trough, projecting outwardly over the flanges **30**, **31** of the cylinder, and then upwardly over the exterior surface of the cylinder so as to bear with spring pressure against the exterior surface thereof, and thereby hold the trough against the interior surface of the barrel cylinder. The trough **85** or **87** acts to scoop or collect articles from the interior of the barrel cylinder as it revolves through the lower arc with the rotation of the cylinder. The double trough **87**, illustrated in Fig. 6, also has the function of depositing new work in the barrel cylinder for electroplating. The trough **87** is open at its side **95** opposite the side **90**, and is provided with a middle

partition 97. Articles may be placed in the trough 87 at the side of the partition 97 through the opening 95, and as the barrel cylinder rotates, carrying the trough 87, articles will be collected in the trough through the opening 90, and, as the rotation of the barrel cylinder continues, articles will be deposited in the bottom of the barrel cylinder from the trough through the opening 95.

A second embodiment of the invention having means for continuously feeding articles into and from the barrel cylinder is illustrated in Figs. 8 to 11. In Figs. 8 to 11, the shaft 40 is hollow as indicated at 100 and is provided on the inside with a spiral rib 102 for conveying articles lengthwise through the interior of shaft 40 into the interior of barrel cylinder 12. Articles to be plated may be fed to the conveyor formed by the spiral rib 102 on the interior of shaft 40 by a hopper 104 which may be supported in suitable manner as by means of an arm 105 attached to the frame 52. The barrel cylinder 12 is also provided on its interior with a spiral rib 107, in addition to the transverse ribs 36. The ribs 36 and 107 may be of metal, when low, but are most advantageously formed of an electrical insulating material, so as to avoid diversion of current from the work resting on the cylinder 12. These strips are also chemically inert to the plating solution. Vinylite meets with these requirements. The spiral ribs 107 act to slide articles lengthwise of the barrel cylinder as they are being electroplated. When the plated articles reach the side of the barrel cylinder opposite the supporting shaft 40, they are picked up by pockets 110 fastened to the cylinder adjacent to the flange 30, and as the pockets rise in the course of the rotation of the cylinder the articles collected therein rise with them, and, when the pockets reach a position at the top of the cylinder, the collected articles are dumped therefrom, and an inclined tray 112 is provided to catch them. The tray 112 may be removably supported at the side of the tank 10 as indicated at 114. The tray 112 is supported at an incline, and projected inwardly through the open side 28 of the barrel cylinder and outwardly over the side of the tank 10. As here shown, a tank 116 may be provided at the side of tank 10, containing water for rinsing the plating solution from the plated articles. The plated articles may be then readily collected from the tank 116.

A third embodiment of the invention, illustrating another means for continuously feeding articles into and from the barrel cylinder is illustrated in Figs. 13 and 14. The structure of the embodiment of Figs. 13 and 14 is generally the same as that of Figs. 1 to 4. In this third embodiment the barrel cylinder 12 is provided with an inside spiral rib 120 (similar to the rib 107, Fig. 8) constructed and arranged to feed articles resting on the cylinder 12 from the shaft supported end 29 toward the opposite end 28, as the barrel-cylinder 12 is turned by its driving mechanism. As in the structure of Fig. 8, when the plated articles reach the side of the barrel cylinder opposite the supporting shaft 40 they are picked up by pockets 125 fastened to the cylinder adjacent to the flange 30, and, as the pockets rise in the course of rotation of the cylinder, the articles collected therein rise with them. When the pockets reach a position at the top of the cylinder, the collected articles are dumped therefrom, and an inclined tray 130 is provided to catch them. The tray 130 is supported at an incline, and projected inwardly over the side of tank 10. The plated articles slide from tray 130 into a tank 116, similar to the plated articles in Fig. 8.

Articles to be plated are fed into the cylinder by an electrically non-conducting or surface insulated chute 135 which projects through the open end 28 of the cylinder, at one side of the anode 70, and extends at its lower end to a point near the shaft supported side 29 of the barrel cylinder. The chute 135 advantageously has the form of a tube, which may be expanded at its outer end to provide a funnel 136, and which at its inner end is bent to one side at an angle of approximately 90°, as indicated at 137, so that it may face the cylindrical wall of the cylinder 12. By bending the end 137 as described, articles sliding down the chute 135 are deflected on exit toward the cylindrical wall of the cylinder, and are thereby kept from passing out of the cylinder 12 through the openings in the end 29. Articles may be fed into the end 136 of chute 135 by hand. However, an automatic hopper feed of any well known construction will usually be employed to feed articles to be plated to the end 136 of the chute. An automatic hopper feed is diagrammatically shown in Fig. 13 at 140.

Operation

The barrel cylinder 12 is rotated at a suitable speed from the motor gearing unit 55 through pulleys 57, 58 and belt 59. For chromium plating the speed of rotation should be such so that the articles being plated within the cylinder are intermittently tumbled. The longitudinal ribs 36 prevent sliding of the articles on the inside of the cylinder and assist in tumbling.

Plating current from a generator passes to the anode 70 from conductor 80 and shaft 72. Current passes from the anode through the plating solution to the work resting in electrical contact with the cylinder 12, and then from the cylinder 12, hub 44, shaft 40, disk or pulley 58, brushes 61, 62, and cathode bus-bar 67 back to the generator.

The temperature of the plating solution is regulated by controlling the flow of a thermal medium through the coil 14.

The exhaust fan 22 operates to remove fumes and spray arising from the surface of the plating solution in the tank 10. The bearings 50, 51 and the brushes 61, 62, being remote from this exhaust, are thereby protected from fouling by the fumes and spray which would cause variations in the plating current. The electrical connections of the motor 23, motor 55 and anode are likewise protected.

When plating of the articles in the barrel cylinder 12 has been completed, in the construction illustrated in Figs. 1 to 6 inclusive, the workmen insert either a trough 85 or a trough 87 longitudinally across the interior of the barrel cylinder. The spring strips 93 project alongside the outside of flange 30 and the tongues of the strips bear on the exterior of the cylinder, and press the trough against the interior of the barrel cylinder, with the edge of the opening 90 bearing closely against the cylinder. The position of the trough at the time of attachment is shown in full lines in Figs. 5 and 6. As the barrel cylinder rotates, and the trough passes through the bottom-most position of the cylinder, the plated articles in the cylinder are collected, as illustrated in dotted lines in Figs. 5 and 6, and then lifted up to a position above the level of the solution in the tank. The workman then separates the trough from the barrel cylinder, withdraws it through the open end 28 of the cylinder, and then empties

the contents of the trough. To deposit articles to be plated in the barrel cylinder at the same time that plated articles are collected from the cylinder, the double trough illustrated in Fig. 6 is used. Articles to be plated are put into the side of the trough which opens upwardly. As the barrel cylinder rotates, the trough is carried through the lower position of the cylinder, collecting plated articles through the opening 90, as heretofore described, and, shortly thereafter, as the trough rises, the unplated articles are deposited in the barrel cylinder through the open side 95 of the trough. See the dotted line position, Fig. 6.

When no more articles are to be plated, the anode 70 is moved out of the solution to prevent the formation of an insulating chromate film thereon. This is readily done by rotating shaft 72 which carries the anode until the anode is moved from the position shown in Fig. 3 to the position shown in Fig. 4.

The shape and diametrical projection of the anode into proximity with the surface of the barrel is of importance in obtaining good plating results with different types of work. To make use of an anode better suited than another anode to the type of work being electroplated, the fastening means 73 are loosened or removed, and the proper anode substituted and then fastened in place.

To effect complete removal of the anode from the barrel cylinder and tank, as for replacing anodes, or for other purposes, the detachment is readily effected. The shaft 72 on its cantilever bearing 75 is pressed downwardly at its outer end and lifted upwardly at its inner end, and then simply lifted out of the barrel cylinder and away from the tank. The shaft in its tilted position free from the hook bearing 77 and the crotch bearing 75 being open at the top, offers no obstruction to the removal of the shaft 72 and anode 70.

Referring to Figs. 8 to 11, the operation of the plating barrel is like that described in references to Figs. 1 to 6 except that the feeding of the articles into and out of the barrel cylinder 12 is automatic.

In the construction illustrated in the later figures, the articles to be plated are fed from the hopper 104 into the hollow in shaft 40, and are then moved forward into the barrel cylinder by the spiral rib 102. The articles fall into the barrel cylinder at the end adjacent the shaft 40, and on reaching the bottom of the cylinder they are continuously fed lengthwise toward the open end 28 by the spiral rib 107. While the articles are being plated, they are intermittently tumbled with the assistance of the ribs 36 and at the same time fed lengthwise along the barrel cylinder by the ribs 107. At the side 28 of the cylinder 12, the plated articles are picked up by the pockets 110 and then lifted up in the course of the rotation of the cylinder to a position where the articles are dumped out of the pockets. This position is shown in Fig. 8. The plated articles dumped from the pockets 110 are caught by the inclined plate 112, and slide down the plate to a place of delivery, for example a water tank 116, in which plating solution is washed from the plated articles.

Referring to Figs. 13 and 14, the operation of the plating barrel is like that described in reference to Figs. 1 to 6 except that feeding of the article into and out of the cylinder 12 is automatic, similar to the operation in Figs. 8 to 11. In Fig. 13, articles to be plated are fed into the end 136 of the chute 135, either by hand, or from an automatic hopper feed. The articles fed to the chute 135 slide down the chute and are discharged inside of the cylinder 12 adjacent the shaft supported end 29. From the shaft supported end 29 of the cylinder 12 the articles are continuously fed lengthwise towards the open end 28 by the spiral rib 120. They are also intermittently tumbled as in the embodiment of Fig. 8. At the side 28 of the cylinder, the plated articles are picked up by the pockets 125, dumped onto the inclined plate 130 and discharged into a washing tank 116, similar to the operation in Fig. 8.

What is claimed is:

In an electroplating barrel for barrel plating articles with chromium or with other metals difficult to electroplate comprising a tank for holding a plating bath, a rotatable open-ended article-supporting metallic cylinder supported on the tank for partial immersion in the bath, a horizontal conducting shaft electrically and structurally connected at one end of the cylinder by means of which the cylinder is rotated, means for electrically connecting the shaft to the cylinder, an anode supported in the cylinder, means for rotating said cylinder shaft and the cylinder connected thereto, and means for connecting said cylinder and the anode in an electric circuit through the plating bath, the improvement in which said cylinder is imperforate, said cylinder having a conducting inner cylindrical surface and having electrical insulation covering the outer cylindrical surface thereof to avoid diversion of current between the anode and articles supported in said cylinder, said electrical connecting means between the cylinder and its supporting shaft comprising a split tapered threaded hub attached to the cylinder for receiving the shaft, and a nut for said threaded hub acting to force the split end of the hub into binding engagement and firm electrical contact with the shaft, said hub and nut also permitting the cylinder to be detached from the shaft, said means for rotating the cylinder and cylinder shaft comprising a conducting pulley on the cylinder shaft and a non-conducting driven belt for driving said pulley, and said means for connecting the cylinder and anode in an electrical circuit including contact brushes in contact with said conducting pulley.

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