Dec. 1, 1964 R. E. BELKE 3,159,560

ELECTROPLATING BARRELS

Filed Jan. 31, 1962 2 Sheets-Sheet 1

Fig. 1.

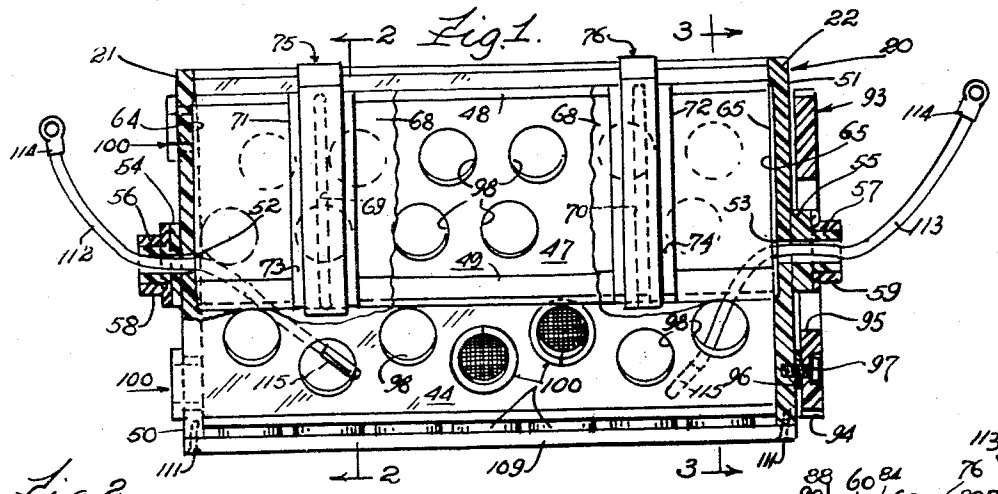


Fig. 2.

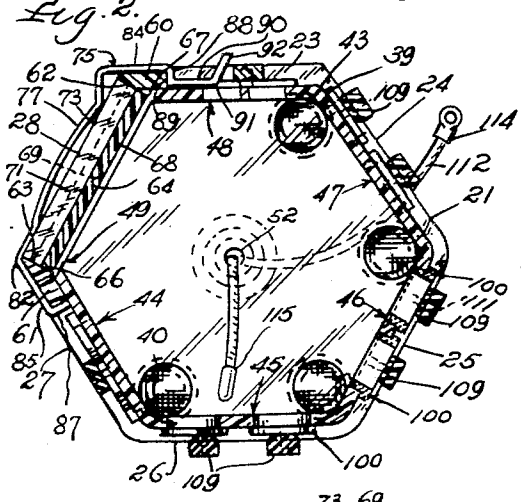
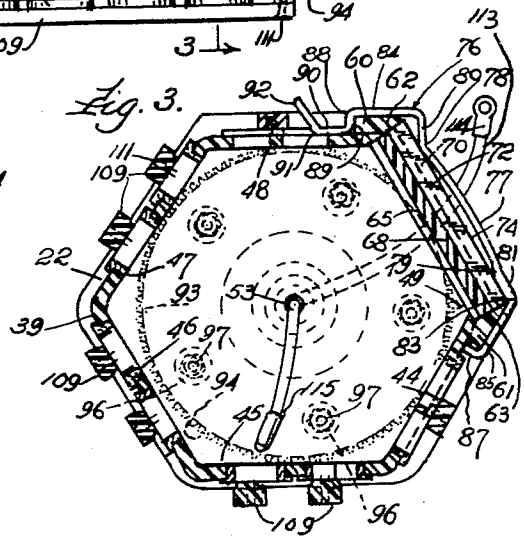


Fig. 3.



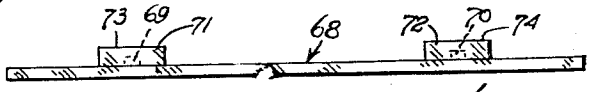
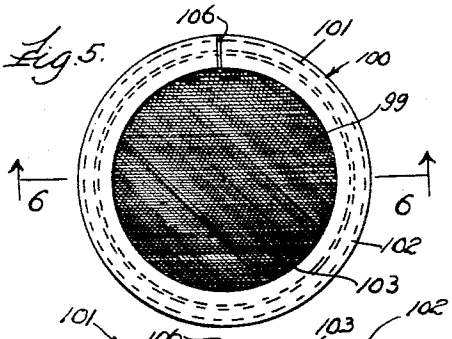


Fig. 4.

Fig. 5.



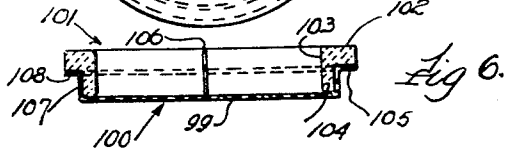


Fig. 6.

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Dec. 1, 1964 R. E. BELKE 3,159,560

ELECTROPLATING BARRELS

Filed Jan. 31, 1962 2 Sheets-Sheet 2

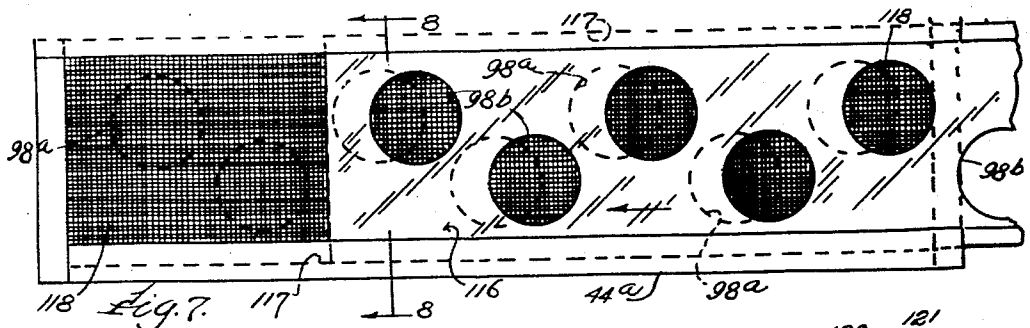


Fig. 7.

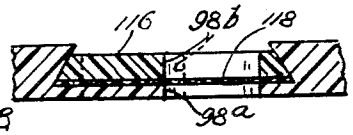


Fig. 8

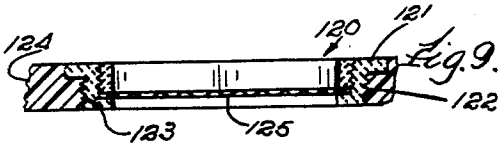


Fig. 9.

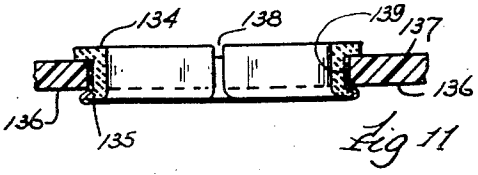


Fig 11

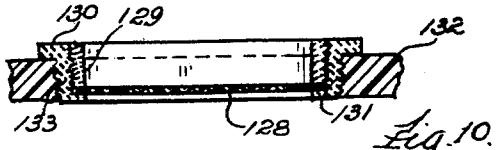


Fig. 10.

Fig 12.

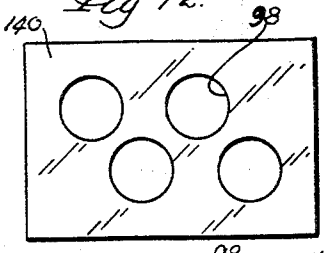
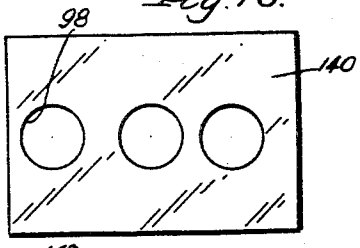


Fig. 13.



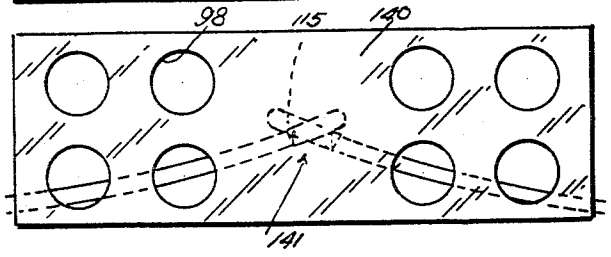


Fig 15.

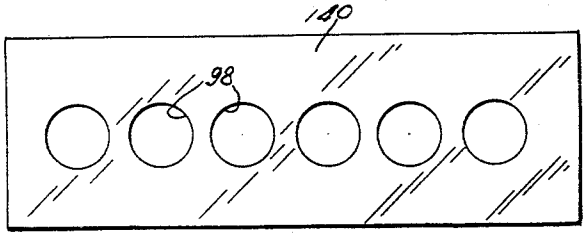


Fig 14.

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ELECTROPLATING BARRELS

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12 Claims. (Cl. 204—213)

The present invention relates to electroplating barrels, and is particularly concerned with an improved construction for electroplating barrels which are adapted to be used for plating extremely small articles, such as those which are used as component parts of extremely small size for electronic assemblies and other elements employed in miniaturization.

In the use of electroplating barrels according to the prior art the barrel walls have been provided with a multiplicity of small apertures of sufficient size to permit the electroplating fluid to circulate through the barrel walls, while still retaining all the articles to be electroplated and avoiding the tendency of such articles to become caught in the apertures in the barrel wall.

These electroplating barrels of the prior art have the disadvantage that a great deal of labor is required to drill the many small apertures in the barrel wall; and as the parts to be electroplated have become smaller and smaller, the decreasing size of the wall apertures has reduced the amount of circulation of the electroplating fluid into and out of the barrel, rendering it necessary to increase the circulation by artificial means, such as eccentric movement of the barrel on its trunnions or the movement of the barrel longitudinally on its supports to cause the fluid to pass into the barrel to be replenished constantly.

One of the objects of the invention is the provision of an improved barrel construction in which the fluid circulation apertures may be made of larger size and covered with a chemically inert strainer fabric which is of sufficient strength to resist abrasion by the articles in the barrel or wear by the dangling electrodes, while still facilitating a maximum circulation of the electroplating fluid through the fabric so that the solution in the barrel will never become impoverished or starved with regard to the metallic components in the fluid for effecting the plating.

Another object of the invention is the provision of an improved barrel construction in which the inert plastic screening fabric is readily replaceable and secured across the apertures in a manner which makes it quickly detachable and adapted to be quickly replaced, although securely held by auxiliary securing devices, which assure the securement of the screen throughout its useful life.

Another object of the invention is the provision of an improved barrel construction provided with larger apertures covered with plastic screen, the apertures being of such size in relation to the strength of the screen that the screen does not sag and is not subjected to excessive mechanical action in its normal use.

Another object of the invention is the provision of an improved electroplating barrel of the class described which is adapted to be employed for plating very fine and minute articles, some of which have parts that are very sharp and tiny or of a size similar to the head of a pin, without the articles catching in the mesh, and which barrels are also adapted to permit maximum circulation, as evidenced by very quick drainage of the barrel in a few second's time.

Another object of the invention is the provision of improved electroplating barrels which are simple in construction, capable of economical manufacture, adapted to be used for a long period of time without need for repair, and adapted to be made of many different sizes, all of which operate more efficiently than the barrels of the prior art.

Other objects and advantages of the invention will be apparent from the following description and the accompanying drawings, in which similar characters of reference indicate similar parts throughout the several views.

Referring to the drawings, of which there are two sheets,

FIG. 1 is a side elevational view in partial section, showing an electroplating barrel embodying the invention, with the cover side turned toward the front and the cover broken away to expose the interior;

FIG. 2 is a sectional view taken on the plane of the line 2—2 of FIG. 1, looking in the direction of the arrows;

FIG. 3 is a sectional view taken on the plane of the line 3—3 of FIG. 1, looking in the direction of the arrows;

FIG. 4 is a side elevational view of the cover shown edgewise;

FIG. 5 is a plan view of one of the strainer units;

FIG. 6 is a sectional view taken on the plane of the line 6—6 of FIG. 5, looking in the direction of the arrows;

FIG. 7 is a fragmentary view in perspective of a modified form of barrel in which each side is provided with a dovetailed groove above a plurality of strainer apertures, the groove receiving a continuous strip of strainer fabric, which is held in place by a plate fitting above the fabric in the dovetailed groove and having registering apertures;

FIG. 8 is a fragmentary sectional view taken on the plane of the line 8—8 of FIG. 7;

FIG. 9 is a sectional view similar to FIG. 6 of a modification of the strainer unit in which the screen fabric is secured between a pair of threaded rings which are held in threaded apertures in the barrel wall;

FIG. 10 is another similar view taken through a strainer unit, showing another form of construction;

FIG. 11 is another similar view of another modification;

FIG. 12 illustrates the arrangement of the strainer apertures by a plan view of the side wall of a barrel of smaller size;

FIG. 13 is a similar view, showing another arrangement of strainer apertures;

FIG. 14 is a similar view, showing the arrangement of apertures in a long, narrow barrel wall;

FIG. 15 is a similar view showing the arrangement of apertures in a barrel wall with a view to avoiding the engagement of the screen by the electrodes on the ends of the dangling conductors.

Referring to FIGS. 1–6, **20** indicates in its entirety an electroplating barrel assembly embodying the invention. This barrel comprises a pair of end plates **21** and **22** made of chemically inert plastic material, such as Lucite; which is identified as a polymethylacrylate ester and the plates **21**, **22** are hexagonal in shape, having six sides **23–28**.

The end plates **20**, **21** are made of relatively thick plastic sheet material, and are slightly larger than the barrel wall **39**, which is made in the shape of a hexagonal member so that the end plates project outwardly on all sides, beyond the barrel wall **39**, and may serve as a support for holding other parts of the barrel out of engagement with any surface on which the barrel rests.

The barrel wall **39** comprises a rectangular piece of the same plastic sheet material, which is of sufficient length to encompass five sides of the hexagonal barrel; and the rectangular sheet of plastic is formed with obtuse angular bends **40–43** extending parallel to each other between five rectangular portions of the barrel sheet; and these bends are accomplished by heating the plastic sheet while it is being bent at an obtuse angle, making an integral barrel wall **39**, comprising the integral panels **44–48**, the barrel being open at its sixth side **49**.

The panels and barrel parts are all of uniform length, extending from plate **21** to plate **22**; and the plane ends of the barrel wall **39**, indicated at **50**, **51**, are cemented to the plates **21**, **22**, forming an integral assembly. Any polygonal form may be employed for the end plates and the end walls; but the hexagonal shape is preferred for the usual sizes being manufactured, as the rotation of the barrel turns the articles inside, which are being electroplated, over and over as the barrel rotates, subjecting all sides of the articles uniformly to the electroplating fluid.

Each end plate is formed with an axial bore **52**, **53**; and each end plate has cemented to it an axially located and concentric hub **54**, **55** supporting a cylindrical trunnion **56**, **57**, through which the bores **52**, **53** extend.

The trunnions **56**, **57** are supported by a plastic rubber bearing **58**, **59** in each case; and the bearing, which may be made of hard rubber, has a split permitting it to engage the trunnions **56**, **57** resiliently but with sufficient freedom for free rotation. The bearings are mounted in the usual pair of end plates (not shown), which end plates depend from a supporting frame.

At the open side **49** of the barrel the edges of the barrel wall **39** are provided with a pair of auxiliary longitudinally extending frame members **60**, **61** cemented to the outside of the barrel wall and formed with plane parallel inner surfaces **62**, **63** framing the opening, which is rectangular; and the two end plates are cut way down to a straight shoulder **64**, **65** on each end plate at the opening, each shoulder being in registry with the edge surfaces **66**, **67** of the two parallels **44** and **48**, forming a rectangular inwardly projecting shoulder for supporting the cover **68**.

The cover **68** may comprise a rectangular sheet of the same plastic material of the same thickness as the barrel wall, and fitting in the opening between the surfaces **62**, **63** where the cover is secured, as follows.

For reinforcement a pair of metal bars, such as stainless steel bars **69**, **70**, are embedded and cemented against the outside of cover **68** inside a pair of plastic bars **71**, **72**, the length of which is equal to the width of the cover.

The metal bars end short of the ends of the plastic bars **71**, **72** so that the reinforcing metal bars are entirely enclosed, avoiding exposure to the electroplating fluid.

The plastic bars **71**, **72** are thick enough so that their outer surfaces **73**, **74** may be flush with or slightly below the edges **23** and **27** of the end plates; and the purpose of the plastic bars **71**, **72** is to provide engaging surfaces on the cover to be engaged by the metal springs **75**, **76**, which hold the cover shut.

Each of the springs is covered over all with a protective inert plastic, thereby protecting the springs from exposure to the electroplating fluid. Each spring is heated to 300°, then immersed in the plastic, which is then drained off and the covering is baked to the proper consistency in an oven. These two springs may be identical in shape; and each spring is provided with a curved central portion **77**, which is adapted to engage against the plane surface **73**, **74** of the two plastic bars **71**, **72**, which are cemented to the cover.

Each spring is bent diagonally outward at **78** and at **79** adjacent to but spaced from the edge of the cover. The diagonal bends **78** and **79** each support an outwardly extending portion **80**, **81** of the spring, causing the spring to clear the edges of the opening; and thereafter each spring is bent at substantially right angles at **82**, **83** and provided with a straight portion **84**, **83** of sufficient length

to extend over the longitudinal frame members **60**, **61**, which are cemented to the barrel along the longitudinal edges of the opening **49**.

One end of each spring has an inwardly turned latching end **86** which extends at right angles to the straight portion **85** and is adapted to hook over the edge surface **87** of the longitudinal frame member **61**.

The other end of each spring is bent inwardly at right angles to form a similar latching portion **88** which engages outside the edge surface **89** of the longitudinal frame member **60** at the opposite edge of the opening **49**. The latching portion **88** has a straight extension **90** extending at right angles to the latching portion **88**; and this extension **90** is bent outwardly at **91**, leaving a diagonally extending handle portion **92**.

An outward pull on the handle portion **92** bends the springs **75**, **76** sufficiently to lift the latching portion **88** free of the frame member **60**, permitting removal of the springs which hold the cover.

The springs are applied by first hooking the flange or latching portion **86** on the edge surface **87** in proper longitudinal position of the barrel and pressing downward on the portions **80** or **84** until the spring snaps into securing position, as shown in FIGS. 2 and 3.

The barrel is provided at one end with a gear plate **93**, comprising a relatively thick plate of the same material provided with teeth and tooth spaces **94** about its circular periphery; and the gear may have a central aperture **95** spacing it from the hub **55**.

The gear is also spaced from the adjacent end wall **22** by a plastic spacer **96**; and the gear is secured to the end wall **22** by a plurality of stainless steel screw bolts **97** passing through the gear and threaded into the end plate; and the screw bolts may be covered with plastic cement surrounding the heads, which are countersunk in the gear.

The gear engages suitable driving gears for rotating the barrel at the usual rate of speed.

The barrel wall **39** and either or both of the end plates **21** and **22** are provided with a multiplicity of relatively large openings **98**, these openings being circular in shape for economical manufacture; and the openings may be arranged in various patterns to effect maximum circulation of the electroplating fluid into and out of the barrel.

Each of the openings **98** is provided with a strainer fabric **99** in the form of a woven cloth having a mesh which may comprise from 40 to 300 openings per square inch; and the cloth may be woven of an inert plastic, such as Saran which is identified as a polyvinylidene chloride resin composition or glass fiber, polyethylene or polypropylene.

The mesh fabric **99** may be varied in the size of its openings, depending on the size of the articles to be electroplated, the fineness of the mesh being increased for the smaller sizes of articles, the purpose being to avoid the penetration of any small articles into the mesh openings.

The fabric mesh **99**, which covers the opening **98**, is preferably in the form of a strainer unit **100**, including a plastic ring **101**. The ring **101** is preferably formed with a radial flange **102**, a through bore **103**, and a cylindrical portion **104**, so that the cylindrical portion **104** with the screen **99** may be received in each of the openings **98**, its insertion being limited by the radial flange **102**, the annular surface **105** of which engages the outside of the barrel.

The rings **101** may be made of similar plastic inert material, but are preferably made of a material such as melamine or polypropine, which is resilient; and the ring is provided with a split **106**, permitting it to be sprung together and permitting it to spring outwardly into engagement with the openings **98**.

The mesh fabric **99** is preferably made of cup shape and formed from the flat sheet into that shape by the application of heat, thus providing a cylindrical wall portion **107**, which extends over the cylindrical portion **104** of each ring, and also with an outwardly turned radial

portion **108**, which engages the outside of the barrel and the radial flange **102**.

This provides a strainer unit **100**, which can be quickly removed and replaced, and which is frictionally held in the openings **98**. The thickness of the mesh fabric is taken into account in forming the size of the cylindrical portion **104** of the ring, since the mesh fabric is between the cylindrical part **104** and the edge of the opening **98**.

The strainer units may be installed in all of the barrel walls or panels, as well as the end plates **21** and **22**; but the drainage is effected so quickly by these units that a reduced number may be employed, instead of those shown in the drawings, to accomplish the desired results.

The strainer units may be secured in the panel apertures by longitudinally extending plastic frame members **109**, which are secured to the end plates **21** and **22** and provided with inwardly projecting angular ridges **110** which engage the outside of the rings **101**, assuring their securement in the openings **98**.

The frame members **109** may be secured to the end plates **21**, **22** by stainless steel screw bolts **111**, the heads of which are protected by plastic cement. The through bores **53** in the ends of the barrel are used to pass the insulated electrical conductors **112**, **113**, each of which has a connector **114** at its outer end for connection to the electric circuit, and each of which has an elongated electrode **115** on its inner end dangling into the barrel to engage the articles being electroplated.

Referring to FIG. 7, this is a modification with a fragmentary view of one of the panels of the barrel, such as the panel **44***a* showing a modified form of securing the plastic mesh over the openings in the barrel.

The panel **44***a* is exemplary of all of the panels of a modified barrel; and it has the same enlarged openings **98***a* which register with openings **98***b* in a cover sheet **116** of the same plastic material. The panel **44***a* has a dovetailed groove **117** extending from end to end of the barrel panel.

The plastic screen **118** is in the form of a continuous sheet extending from end to end of the groove **117** and covering the openings **98***a*. The cover sheet or plate **116** is of complementary dovetailed form, leaving room for the mesh fabric **118** below it; and the cover plate **116** slides in endwise above the fabric mesh **118**, the openings **98***a*, **98***b* registering with each other.

Referring to FIG. 9, this shows a modified form of strainer unit **120**, the supporting ring **121** of which has threads **122** engaging threads **123** in the panel wall **124**. The fabric mesh **125** is of cup shape with a cylindrical portion **126**; and it is engaged by a threaded ring **127** threaded into the ring **121**.

Referring to FIG. 10, this is a modification in which the fabric mesh **128** is of cup shape and mounted on the cylindrical portion **129** of a retainer which is carried by a head **130** and is located in a threaded bore **131** in the panel **132** and secured by threading the cylindrical part **133** into the bore by the head **130**.

Referring to FIG. 11, this is a modification similar to FIG. 5, in which the split ring **134** is of the same construction, but has an annular hump **135** which extends past the inner surface **136** of the barrel wall **137**. The ring **134**, which has a split **138**, expands inside the aperture **139**; and the hump **135** retains the ring **134** in the bore.

Referring to FIGS. 12–15, these are modified diagrams showing the arrangement of the openings **98** in the panels of smaller barrels. These are so arranged that a lesser number of openings and strainer units may be employed; and in FIG. 15 the barrel wall **140** has the openings **98** arranged toward the ends of the barrel so that the electrodes **115** in the middle of the barrel do not engage the mesh fabric, but are located at an imperforate area **141** of the barrel wall.

It will thus be observed that I have invented an improved electroplating barrel which may be employed for electroplating very fine and minute articles and the openings in the wall are of larger size, involving less labor in their formation than the many drilled openings of the prior art; but they are closed by fine plastic mesh screen which permits a maximum circulation of the electroplating fluid into the barrel.

The plastic mesh may be replaced and is of small area so that it will not bulge and the mesh is such that the very smallest articles being electroplated will not catch in the mesh.

While I have illustrated a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself to all changes within the scope of the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States, is:

1. An electroplating barrel comprising a pair of end wall plates of chemically inert plastic material, said plates being of polygonal shape, a side wall member of similar material comprising a rectangular plastic sheet having a plurality of parallel bends at obtuse angles forming a barrel wall corresponding in sides to the number of sides of each end plate with one side of the barrel open, and a rectangular cover plate receivable between the end plates and engaging the opposite edges of the open side of the barrel, the said barrel being provided with a plurality of enlarged openings for passing electroplating fluid, and a woven plastic fabric of chemically inert material covering said enlarged openings and adapted to pass the electroplating fluid, but adapted to retain small articles to be electroplated with a minimum penetration of said articles in the fabric.

2. An electroplating barrel according to claim 1, in which the said plastic fabric is in the form of a continuous sheet, confined between two plastic apertured plates, forming one of the walls of said barrel.

3. An electroplating barrel according to claim 2, in which the latter wall has a dovetailed groove in which the plastic fabric lies, and the second plate is complementary in shape to said groove and engages and holds the fabric in the groove.

4. An electroplating barrel according to claim 1, in which the fabric is woven cloth of a polyvinylidene chloride resin having a mesh between 40 to 300 openings per square inch.

5. An electroplating barrel according to claim 1, in which the openings are each provided with a removable and replaceable strainer unit including a round piece of woven plastic fabric extending over the area of each opening and held by a plastic retainer.

6. An electroplating barrel according to claim 5, in which the openings are circular and the retainer is a flanged ring engaging and securing the plastic fabric in each circular opening.

7. An electroplating barrel according to claim 6, in which the plastic fabric of each strainer unit is cup shaped and fitting on the retainer ring and engaged by the edges of the barrel wall in each opening.

8. An electroplating barrel according to claim 7, in which the retaining ring is split and resilient for engaging the cup shaped fabric and securing it in each opening.

9. An electroplating barrel according to claim 5, in which the end plates carry a frame member extending longitudinally from plate to plate and engaging the strainer units to lock a plurality of them in said openings.

10. An electroplating barrel according to claim 5, in which the end plates each have a central trunnion provided with a through bore having an electric conductor extending into the barrel and provided with an electrode at the inner end of the conductor.

11. An electroplating barrel according to claim 10, in

which the openings are located out of the range of engagement and abrasion by the electrodes.

12. An electroplating barrel for small fine articles, comprising a hexagonal barrel of a polymethacrylate ester having one open side wall closed by a plate of said ester, the ends of said barrel comprising plates of said ester cemented to the ends of the side wall and the side walls having enlarged cylindrical openings, and a plurality of strainer units in said openings, each strainer unit comprising a split ring of said ester fitting in said enlarged openings when a mesh fabric of a polyvinylidene chloride resin is curved about the edges of each split ring and the ring with said resin is forced into each opening against an annular shoulder carried by each ring.

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