June 20, 1944. S. COULSON 2,351,586

APPARATUS FOR ELECTROPLATING CYLINDERS

Filed Dec. 20, 1941 2 Sheets-Sheet 1

Fig. 1.

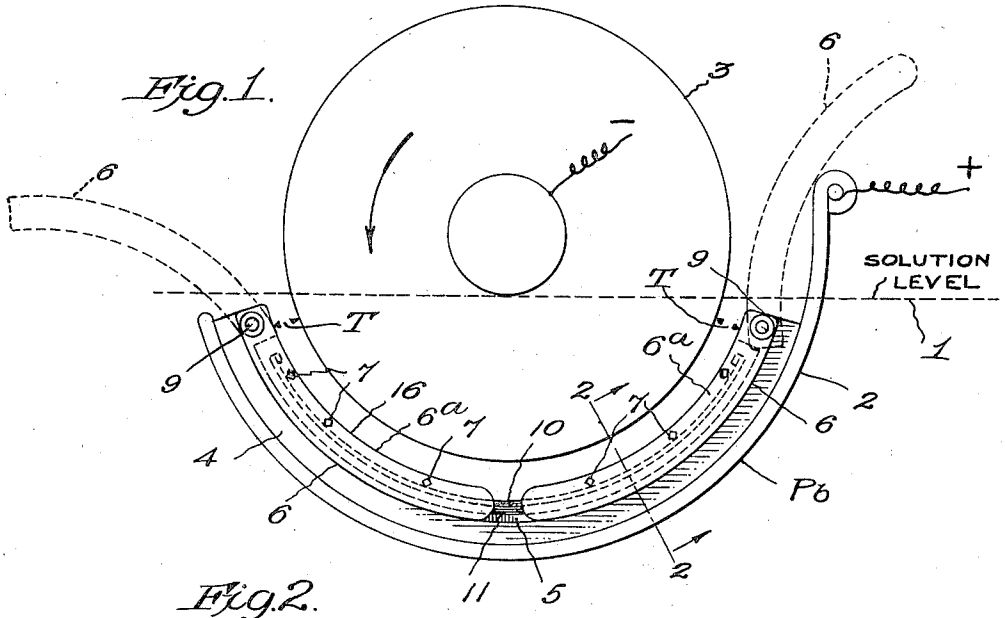


Fig. 2.

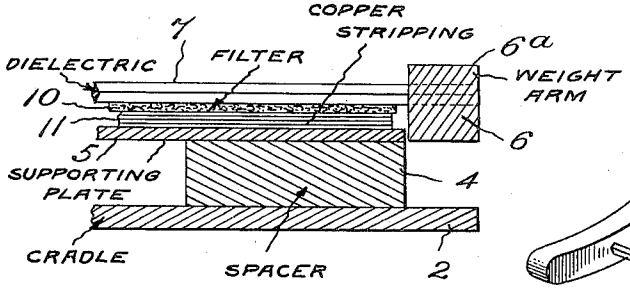


Fig. 3.

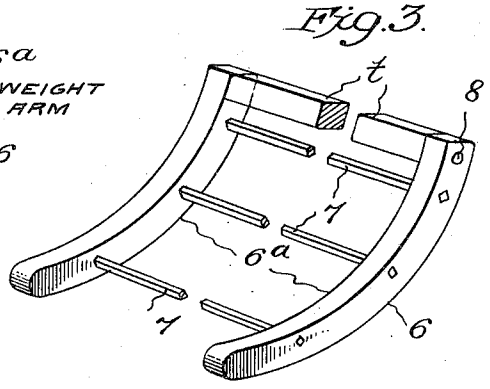


Fig. 4.

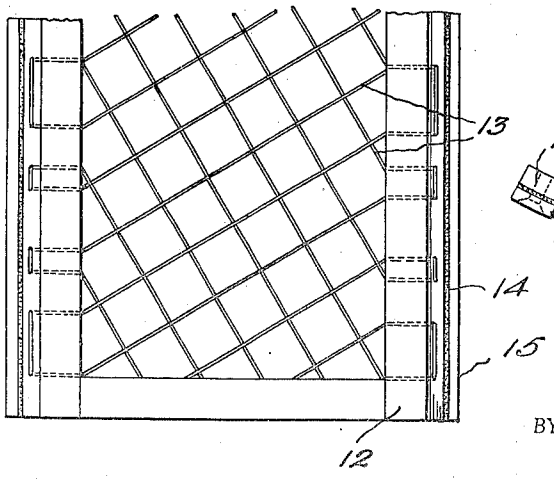
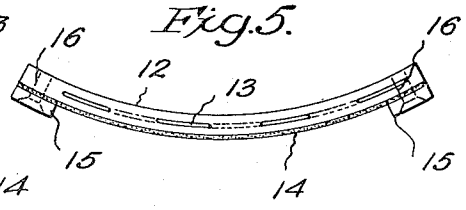


Fig. 5.



INVENTOR.
SILAS COULSON
BY Cornelius Fabricius
ATTORNEY

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APPARATUS FOR ELECTROPLATING CYLINDERS

Filed Dec. 20, 1941 2 Sheets-Sheet 2

Fig. 6.

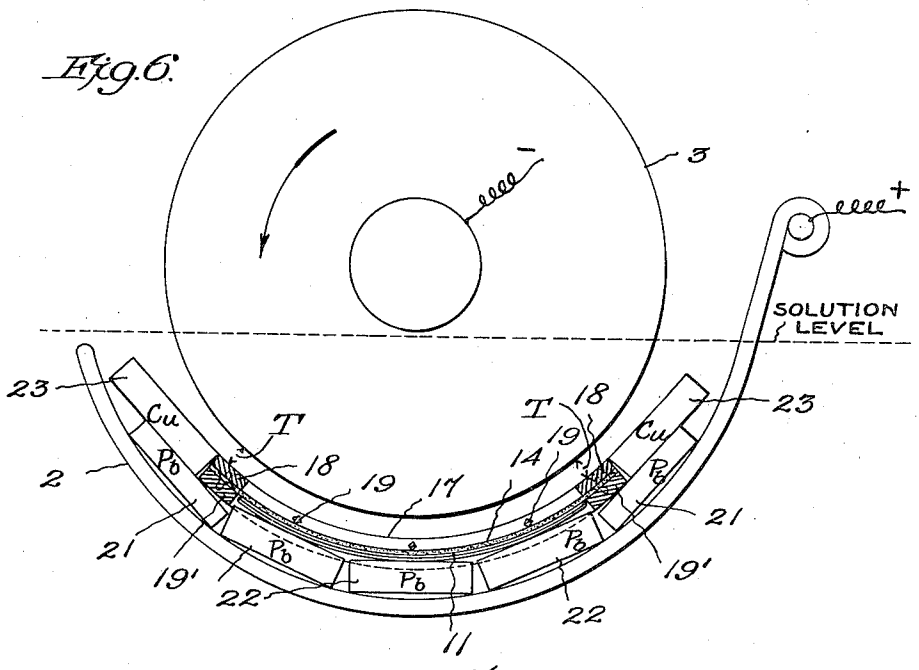


Fig. 7.

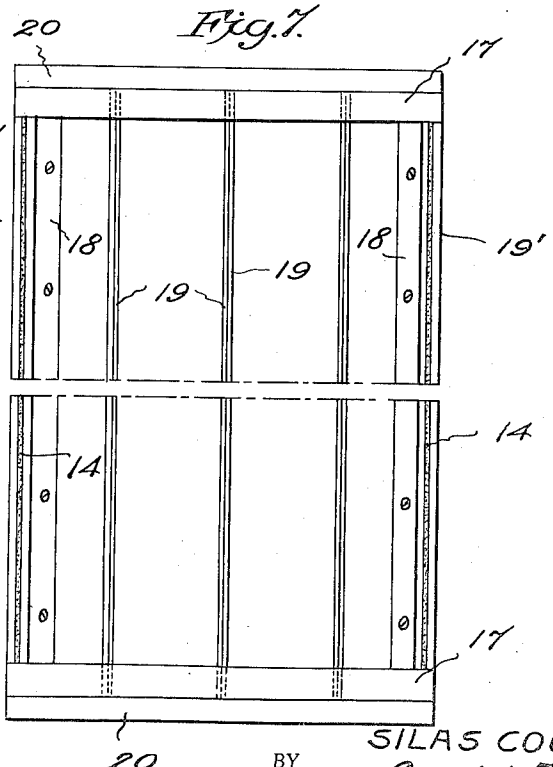
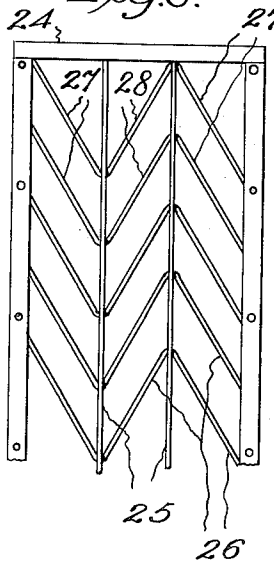


Fig. 8.



INVENTOR.
SILAS COULSON
BY Cornelius Falvey Jr.
ATTORNEY

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2,351,586

UNITED STATES PATENT OFFICE

2,351,586

APPARATUS FOR ELECTROPLATING CYLINDERS

Silas Coulson, Jackson Heights, N. Y.

Application December 20, 1941, Serial No. 423,750

8 Claims. (Cl. 204—212)

This invention relates to the electroplating of rotogravure printing cylinders and is directed more particularly to the provision of apparatus whereby thin copper shells taken from rotogravure cylinders, that have been etched and that have served their purpose, may be employed as anode copper for the plating of the same or another cylinder. Heretofore it has been the practice to dispose of the used shells and to employ solid bars of copper made expressly for the purpose by melting down such shells into such bars and by using virgin copper for this purpose. Because of the present war effort, however, it is becoming increasingly difficult to obtain these copper bars, and the object of the present invention is to provide apparatus whereby used shells may be employed as a substitute therefor.

I am aware that copper scrap has heretofore been employed in the electroplating field, but the use of such scrap has never been satisfactory in the plating of rotogravure cylinders. Such scrap has generally been deposited within foraminous baskets and similar receptacles in such manner that the distance between various portions of the scrap and the surface of the cylinder varies to such degree that no satisfactory deposition of the plate upon the cylinder was possible. Experience has shown that, in order to obtain satisfactory plating of a substantially uniform shell upon the cylinder, it is necessary to maintain a substantially uniform distance between the anode and the cathode, particularly where a heavy electric current flow is maintained between these parts and where scrap is deposited in a basket or similar container such a condition cannot possibly persist during the period necessary to effectually plate a rotogravure cylinder.

In practically carrying out the present invention, a cylinder which has served its purpose, is divested of its embracing copper shell by slitting the shell longitudinally and stripping the same from the cylinder. The shell may be then either slit longitudinally into strips of convenient width or it may be folded transversely to appropriate size and flattened between rollers or manually as may be desired. The resulting flattened shell is thereupon associated with one or more frames which are of arcuate form and so disposed that their axes are common to the axis of the cylinder to be plated. The frames are immersed in an electrolyte and the copper shell associated therewith thereupon becomes the anode of the electroplating apparatus.

The frame or frames employed in carrying out the present invention may be conveniently supported in proper cooperative relation to the cathode cylinder by a cradle of the character disclosed in the Ernest S. Ballard Patent No. 1,918,627, issued July 18, 1933, or the Emil Ericksson Patent No. 2,055,070, issued September 22, 1936. In both cases the electrolyte is contained within a tank provided with bearings for supporting a rotogravure cylinder for rotation, with an appreciable portion of the circumference of such cylinder immersed in the electrolyte. Mounted within the tank is a cradle which underlies the submerged portion of the cylinder and has a curvature coaxial with said cylinder. The cradle serves to substantially isolate a portion of the electrolyte between it and the surface of the cylinder, so that, as the cylinder is rotated, a substantially uniform flow of electrolyte passes through the space thus provided, thereby giving a substantially uniform ionic discharge between the cradle which serves as the anode and the cylinder which functions as the cathode.

In the Ballard patent the anode copper is supplied directly from the electrolyte solution, while in the Ericksson patent the copper is supplied from solid copper anode bars, such as I have hereinbefore referred to. By the present invention, the copper bars of the Ericksson patent may be wholly or partially replaced by stripped copper shell, the same being held in proper spaced cooperative relation to the surface of the cylinder by the frame or frames of this invention, as will be presently explained.

The most efficient spacing of the copper shell is accomplished by the mounting of the frame or frames in a cradle and this spacing of the frame or frames may be adjusted with respect to the cylinder by means of lead spacers interposed between the frame and the supporting surface of the cradle.

An important feature of the present invention resides in the fact that all parts of the anode copper are at substantially uniform distances from the cathode, in contradistinction to the use of deep anode scrap baskets of prior practice. By employing this close uniform spacing, wherein all parts of the anode copper substantially parallel the surface of the cylinder, I am able to place the anode copper very close to such surface and employ relatively heavy current and yet obtain satisfactory electrolytic deposits of copper uniformly throughout the surface of the cylinder.

Moreover the invention consists in so constituting and employing my anode frames, that they are held by gravity in proper cooperative relation with the cathode cylinder. As the distance be-

tween these parts is small and the copper anode shells are relatively thin, I interpose between said shells and the cathode a filter of any appropriate material which will not be detrimentally affected by the electrolyte, such, for example, as glass fibre cloth or wool felt. This filter not only serves to filter the electrolyte, but will hold down the copper shell, which has a tendency to curl or bulge as it becomes thin during use. The use of a filter in this connection, operating as specified, constitutes a feature of this invention.

The filter is, according to this invention, preferably placed between the frame and the anode copper and may, if desired, be permanently secured to the frame, so that the filter is held down and serves, in turn, to hold down and properly space the copper shell from the cathode.

Features of the invention, other than those adverted to, will be apparent from the hereinafter detailed description and claims, when read in conjunction with the accompanying drawings.

The accompanying drawings illustrate different practical embodiments of the invention, but the constructions therein shown are to be understood as illustrative, only, and not as defining the limits of the invention.

Figure 1 is an end elevation of a rotogravure cylinder partially submerged in an electrolyte solution and positioned in cooperative relation with a subjacent cradle on which is supported a pair of cooperating frames embodying the present invention.

Figure 2 is a fragmental section on the line 2—2 of Figure 1.

Figure 3 is a perspective view of one of the frames shown in Figures 1 and 2.

Figure 4 is a plan view of an alternate form of frame.

Figure 5 is an edge elevation viewed from the lower edge as seen in Figure 4.

Figure 6 is a view similar to Fig. 1, but showing a modified form of the invention with the frame thereof illustrated in transverse section.

Figure 7 is a plan view of the frame of Figure 6 removed from the remainder of the apparatus.

Figure 8 is a plan view of a further modified form of frame.

In the accompanying drawings, 1 designates the electrolyte level in an appropriate electroplating tank (not shown) in which is supported a cradle 2 of arcuate cross section. A rotogravure printing cylinder 3 is shown as rotatably supported in any suitable manner partially immersed in the electrolyte, coaxial with the cradle 2 and in spaced relation thereto. Positive electrical current is fed to the cradle 2, which is generally of lead, while the negative pole of the circuit is connected to the cylinder 3 which, in practice, has a polished surface adapted to receive the copper deposit in the form of a uniform plated coating about its periphery.

In the form of the invention shown in Figures 1–3 inclusive, there is laid within the cradle a plurality of arcuate bar spacers 4 of which any suitable number may be used, conveniently three or four. These arcuate spacers are preferably of lead or of some other suitable conductive material. On the spacers is positioned a conductive supporting plate 5 extending for the full length of the cylinder 3 and preferably of lead. The copper shells which have been stripped from used cylinders and flattened or cut into strips, as the case may be, are adapted to be laid upon the supporting plate 5 which constitutes a supporting floor therefor and in such manner as to rest upon and conform to the shape of said plate. Pivoted to the opposite ends of the spacers 4 or plate 5 are frames 6, one of which is shown in Figure 3. Each such frame comprises end arms 6a having a curvature with the same center as the curvature of the cylinder and the cradle and extending between these arms are rods 7 rigidly secured thereto and cooperating therewith to collectively form the frame. All of the frame parts are di-electric. They may be made of any suitable material such as steel covered by lead or rubber but they should be rendered di-electric in any appropriate way, as by a di-electric coating.

One end of each of the arms 6a is perforated, as shown at 8, and on the corresponding ends of the spacers 4 or plate 5 are upstanding lugs similarly perforated. Between the perforated ends of the arms 6a of each of the frames extends a bar t which is preferably of the same thickness as the radial thickness of the arms 6a. This bar t may have a hole through its center registering with the perforations 8 in the arms of the frame and rods 9 extend through the bar, the lugs of the spacers and through the perforations 8 of the arms and thus mount each of the frames for pivotal movement. The bars t of the two frames are important since they establish uniform throats T between the pivoted sides of the frames and the surface of the cylinder, for reasons hereinafter more fully explained.

The flattened copper shells 11 are placed in the cradle before the cylinder 3 to be electroplated is brought into cooperative relation and thus it is possible to swing the free ends of the frames upwardly and outwardly as indicated in dotted lines in Figure 1, so as to uncover the supporting plate 5. The copper shells are then laid upon said plate and over these shells is placed a thin mattress or filter 10 of fibre glass, wool felt, or the like, so as to completely cover the copper shells, and thereafter the lead frames 6 are swung into the full line positions of Figure 1. As shown in Figure 2, the rods 7 are of such length that the arms 6a lie beyond the ends of the supporting plate 5 and thus the weight of the frames is transmitted through the rods 7 directly on to the filter 10 which, in turn, bears upon and holds the several thicknesses of the copper shells 11 together and to a firm seat on the supporting plate 5. Any appropriate number of copper shells or parts of shells may be held down in this manner and the weight of the frames is sufficient to hold them in close conformity with the supporting plate as the electrolyzing operation proceeds. The filter 10 is of course pervious to electronic action and does not interfere with the passage of copper therethrough, to be deposited upon the cylinder 3, as the latter revolves in the usual way to present different portions of its peripheral face to the action of electrolysis.

It is important, moreover, to note that, as the cylinder rotates in the direction of the arrow in Figure 1, there is a constant circulation of the electrolyte between the filter and the cylinder. The intake supply of this flow is in the form of a throat T which is unchanging in its dimension and consequently the flow is constant. Furthermore, since the rods 7 extend transversely of the flow, they cause considerable agitation or turbulence therein, and thus facilitate the electrolytic action. The surface of the anode copper shells is so great that their combined thickness need not be appreciable. Thus, even as they are electrolytically worn away, the distance between the anode copper and the cylinder will not increase

to such extent as to interfere with a substantially uniform electrolytic deposition of the copper.

As the electrolytic operation proceeds, the copper anode shells will of course become very thin and fragile and, in the absence of the filter, would tend to curl up and might, if the intervening space between the anode and cathode were small, contact with the latter and short circuit the shell. With the filter present this cannot occur. However, as the copper shells are used up, the weight of the pivoted frames causes them to continue to bear firmly down upon the anode copper and hold it to a firm seat against the supporting plate 5.

After the cylinder 3 has been plated to the desired extent in the manner specified, said cylinder is removed, the frames swung outwardly and additionally stripped and flattened copper shells are introduced into the cradle in the manner hereinbefore specified, in order that the next cylinder may be plated in the same way.

In Figures 4 and 5, I have shown a modified form of frame. Here a rectangular framework 12, which may conveniently be of lead and is of arcuate form to correspond to the shape of the arms 6a, is strung with wires 13 similar to the manner of stringing a tennis racket, except that none of the wires 13 should be normal to the longitudinal sides of the framework 12. By preference the wires may conveniently extend at 60° and 30°, respectively, or 75° and 15°, respectively, or at other appropriate angles, so that none of the wires will extend in the direction of flow of the current through the throat T, nor will wire intersections line up in the direction of such flow. With this arrangement, said intersections will be staggered transversely of the direction of the electrolyte flow to such extent as to produce maximum turbulence of the electrolyte as it passes over the frame because the intersections will agitate the electrolyte and, since no two are in line, such agitation will be broadcast throughout the entire surface of the frame.

Where wires are strung in the manner described, they are preferably secured to one another at their points of crossing to render the structure more firm and rigid. In practice, I may, in lieu of the wire construction shown, employ an interwoven wire construction or openwork or reticulated metal plates may be secured on the framework 12. In any event, wires or metal plates used in this connection should be either of a dielectric material or properly rendered di-electric with appropriate coatings or otherwise.

The filter 14, used in connection with the frame of these figures, may be loosely laid on the anode copper, as in Figures 1 and 2, or said filter may be clamped to the framework 12, as shown in Figure 5, by means of cleats 15 held in place by screws 16, which thread into the framework, as here shown. It is also possible and in some instances desirable to also clamp the lateral edges of the anode copper shells to the framework by the cleats 15, so that the entire assembly of the frame, filter and anode copper shells can be effected outside of the electrolyte and then placed bodily in position therein.

In Figure 5, the filter 14 is shown beneath the wires 13 and adapted to make direct contact with the under side thereof. If desired, however, this filter may be mounted so as to overlie the wires 13 and framework 12 with its lateral edges passed about the edges of the framework and clamped between the cleats 15 and the framework. With such an arrangement, however, the structure of Figures 4 and 5 should be so used that, when placed in the cradle, it is positioned below frames 6 so that the rods 7 of these frames will serve to hold down the filter and keep it free from contact with the cylinder.

The frame of Figures 4 and 5 is shown of the same size as one of the frames in Figure 1 and two of these frames may be laid in the cradle on the supporting plate 5, so as to loosely rest on said plate by gravity. However, the frame of Figure 4 may be made wide enough so that one frame, instead of two, may be used to cover the width of the supporting plate 5. Furthermore, either one or both of these frames, as the case may be, may be pivotally secured to the supporting plate or spacers as described with respect to Figure 1, to be pivotally movable in the same manner as one of the frames in Figure 1. The frame of Figures 4 and 5 may be made of material which may be buoyant in the electrolyte in which case the frame may be weighted down in any suitable manner as by using copper bars, as hereinafter described in connection with the structure of Figures 6 and 7.

For the purpose of illustration, I have shown the frame in these latter figures as made of wood. It has arcuate end bars 17, while its side bars 18 are approximately one-half the thickness of the end bars 17, so that cleats 19', corresponding to the cleats 15, may serve to clamp between them and the side bars 18, the filter 14 alone or together with one or more copper anode shells. Rods 19, corresponding to the rods 7, extend longitudinally of the frame and through perforations in the end bars 17 thereof and these rods are held in place by external cleats 20 permanently secured to the outer faces of the end bars 17.

The frame shown in Figure 7 may be used with spacers 4 and a supporting plate 5, as described with respect to the previous figures, but in Figure 6 it is shown as supported within the cradle on lead bars 21. Between the bars 21 are positioned lead bars 22 which are sufficiently thicker than the lead bars 21 to reach into the confines of the frame and form a direct support for the copper anode shells. The lead bars 21 and 22 are not affected by the electrolytic action and their thickness thus remains constant so that the throat T in this figure will also remain constant.

The frame of Figure 6 may be held to its seat on the bars 21 by weights 23 which may be of lead, but said weights are shown as bars of copper to augment the supply of copper inherent in the copper shells. The thickness of the bars 21 and 22 will of course depend upon the diameter of the cylinder 3 which is to be plated and the same of course holds true of the thickness of the spacers 4 in Figure 2.

I have hereinbefore referred to certain parts as made of lead. The reason for employing lead is that it is not seriously affected by the electrolyte nor does it pollute the same. I am aware, however, that other materials which are resistant in the same way, or which may be coated by resistant materials, may be employed in lieu of lead, provided that they have the requisite dielectric or conductive properties. For example I may use Monel metal, stainless steel, hard rubber, or plastic materials, either alone or in combination with one another, as the case may be, in the form of bars, rods, strips, or in the shape of angle iron or channel iron to build up the parts which I have described. Where parts are made of a metal which is a conductor of electricity, it may be necessary to coat the same with an insulating

substance to prevent the SO_4 ions from breaking into SO_2 ions plus oxygen and which gases would be lost through the solution, whereas the SO_4 ions should combine with the copper of the anode to form $CuSO_4$ and thus augment the electrolyte solution.

It will be apparent from the foregoing description that, when employing the present invention, the distance between the anode and cathode is practically uniform or so close to uniform as to not materially vary the electrolytic deposition of the copper upon the cylinder. In fact the variation in distance between the anode and cathode of this invention, due to dissolving of the anode as the electrolytic action proceeds, is materially less perceptible than under that prior practice wherein copper bars are employed as a source of anode copper for these copper bars, which initially may be one inch or more in thickness, are commonly used until they are dissolved away to a small fraction of that dimension. As the bars dissolve the distance between the anode and the cathode becomes correspondingly great. Such an increase in this distance cannot possibly occur with the present invention.

The flow of the solution through the throat and the intervening space between the frame and the cylinder is uniform and such being the case, the operator is assured of rapid deposit of that fine crystalline structure so desirable of rotogravure cylinders. Particular attention is directed to the fact that the thin copper anode shells are properly supported throughout their entire extent and this in itself makes it possible to preserve that uniform distance of ionic flow so necessary to uniform plating.

Furthermore, the rods of the frame or wires, as the case may be, produce additional agitation in the electrolyte flow as to keep the cathode film rich in copper ions and the anode film rich in sulphate ions, thereby assuring true and uniform shells and also even corrosion of the anode.

The filter cloth will effectually prevent any ink or foreign substance which has been left on the anode copper shells from reaching the cylinder and at the same time, it will prevent such curling of the thin shells as might result in short circuiting of the apparatus.

In the prior use of copper bars as a source of anode copper, the surfaces of such bars are uniformly flat, so that they present a substantially uniform exposed surface to the action of the electrolyte. This is not the case when a stripped printing shell is employed as in the present invention. In fact, the surface of such shell is microscopically undulating or uneven due to the etching which has previously been performed on the surface thereof. Moreover, this etching is not ordinarily uniform throughout the surface of the shell. One portion of the surface may be wholly unetched. Consequently the ionic flow over the etched portion of the shell will be from a considerably greater surface area than from the unetched portion of the shell with consequent ununiformity in the copper ion feed. If, e. g., one end of a shell is etched and the other end wholly unetched, a much richer flow of copper would result from the etched end, with resulting tendency to produce an uneven deposition of copper upon the cylinder.

I have provided definite means for overcoming such a condition. In Figure 8, I have shown a frame (on a somewhat smaller scale than in the preceding figures) adapted to compensate for the uneven character of an etched shell. This frame is shown as comprising a framework 24 with arcuate ends and with longitudinal intermediate stay bars 25 and across the frame are a series of rods 26 which correspond, according to certain of their functions, to the rods 7 and the wires 13. It will be noted, however, that these rods 26 are of serpentine form, so that the portions 27 of the rods are inclined in one direction with respect to the electrolyte flow through the throats T, while the portions 28 of said rods are inclined in the opposite direction. As a result of this construction, the electrolyte, flowing through the intake throat T, will meet the portions 27, 28, 27 in succession and these inclined portions will serve as baffles to cause the electrolyte flow to be deflected first toward one end of the cylinder and then toward the other end of the cylinder. In other words, as the electrolyte flows between the anode and the cathode, it is swept in one direction longitudinally of the cylinder and then in the opposite longitudinal direction and this longitudinal sweeping of the flow alternately in opposite directions will effect a lateral agitation which will distribute the more heavily copper charged solution uniformly through the space between the anode and the cathode and thus render the deposition on the latter uniform.

It will also be noted in Figure 8 that the intersections of the rods 26 with the side bars of the frame and with the stay bars 25 are staggered in the direction of flow of the electrolyte to obtain maximum turbulence as hereinbefore described. I realize of course that the rods 26 may be of other shapes than as shown, but a generally herringbone pattern will give satisfactory results. The longitudinal side bars of the frame in the structure of Figure 8 forms the throats T to which reference has hereinbefore been made.

In the different figures of the drawings, I have shown frames of various forms, certain of which have bars for holding down the filter and the copper anode shells and another of which is in the form of a framework with wires extending across the same. Both the rod and wire form of frames constitutes grids and these constructions, as well as equivalent forms, will be generally referred to as such in the appended claims.

The manner of stripping electrolytically deposited shells from cylinders, flattening them out and then holding them in coaxially spaced relation to a rotating cylinder while submerged in an electrolyte, also constitutes a novel method forming part of this invention.

The foregoing detailed description sets forth the invention in its preferred practical form, but the invention is to be understood as fully commensurate with the appended claims. Copper has been referred to as the plating metal but other substitute metals, whose use may be required under wartime emergency, are within the invention.

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

1. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, a filter overlying said

copper sheets and substantially coextensive therewith, a grid bearing down upon the filter to hold the filter and copper sheets in substantially uniform arcuate spaced relation to the surface of the cylinder.

2. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, a dielectric filter overlying said copper sheets and substantially coextensive therewith, a dielectric grid bearing down upon the filter to hold the filter and copper sheets in substantially uniform arcuate spaced relation to the surface of the cylinder.

3. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, and a grid bearing down upon the copper sheets to hold them in substantially uniform arcuate spaced relation to the surface of the cylinder.

4. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, and a grid pivotally carried by the support and bearing down upon the copper sheets to hold them in substantially uniform arcuate spaced relation to the surface of the cylinnder.

5. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, and a grid overlying the copper sheets to maintain them in arcuate spaced relation to the surface of the cylinder and out of contact therewith.

6. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, and a grid overlying the copper sheets to hold them in arcuate spaced relation to the surface of the cylinder and out of contact therewith, said grid comprising baffles inclined in opposite directions with respect to one another and also inclined with respect to the flow of the electrolyte adapted to pass between the grid and the cylinder when the cylinder is rotated.

7. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, and a grid overlying the copper sheets to hold them in arcuate spaced relation to the surface of the cylinder and out of contact therewith, said grid comprising parallel side arms and a screen between said side arms with the rods of the screen arranged in non-perpendicular and non-parallel relation to said side arms to promote agitation and turbulence of the electrolyte when the cylinder is rotated.

8. In an electroplating apparatus having a cylindrical rotatable cathode, a container for electrolyte beneath the cathode with the electrolyte partially immersing said cathode, and a support arranged below the immersed portion of the cathode and substantially coaxial therewith, the combination with the aforesaid support, of an anode assembly comprising; sheets of stripped copper shell in face abutting relation to one another carried by said support and substantially coaxial with the cylinder, a filter overlying said copper sheets and substantially coextensive therewith, and a grid overlying said filter to hold the filter and copper sheets in arcuate spaced relation to the surface of the cylinder and out of contact therewith, said filter being secured to the grid.

SILAS COULSON.