Feb. 9, 1960 W. H. JACKSON 2,924,564

SELECTIVE PLATING APPARATUS

Filed May 3, 1956 6 Sheets-Sheet 1

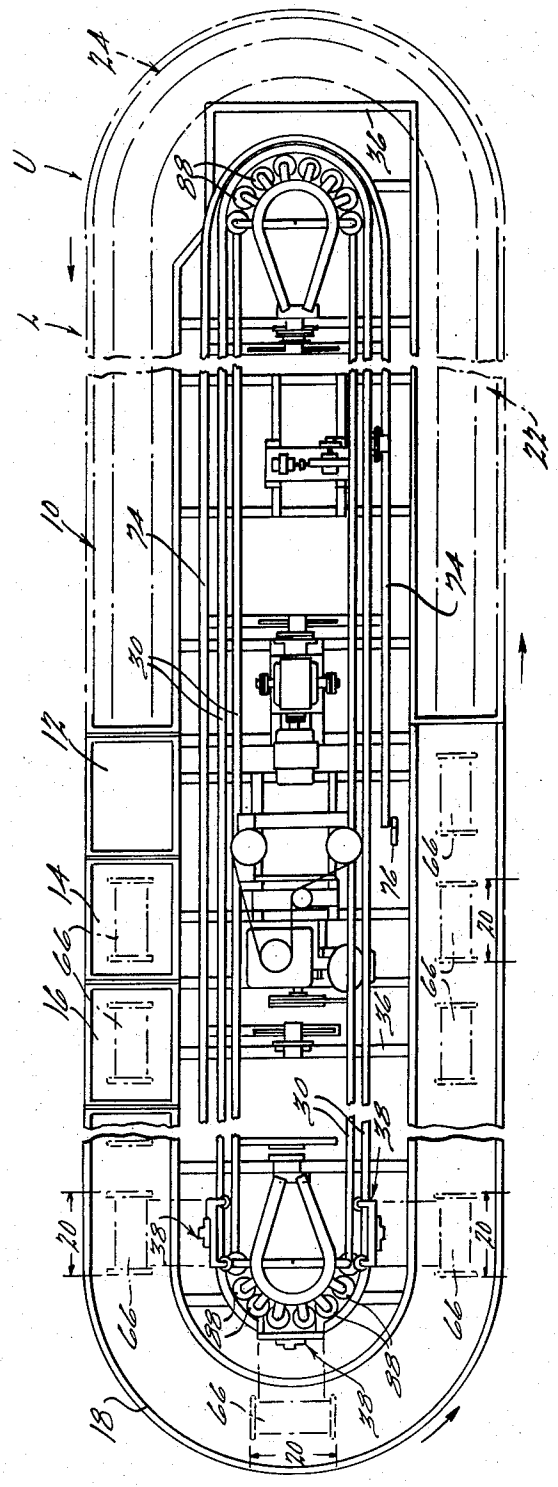


Fig. 1.

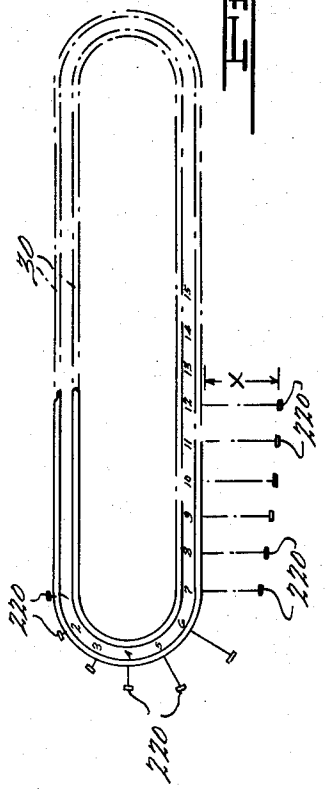


Fig. 1A.

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Feb. 9, 1960 W. H. JACKSON 2,924,564

SELECTIVE PLATING APPARATUS

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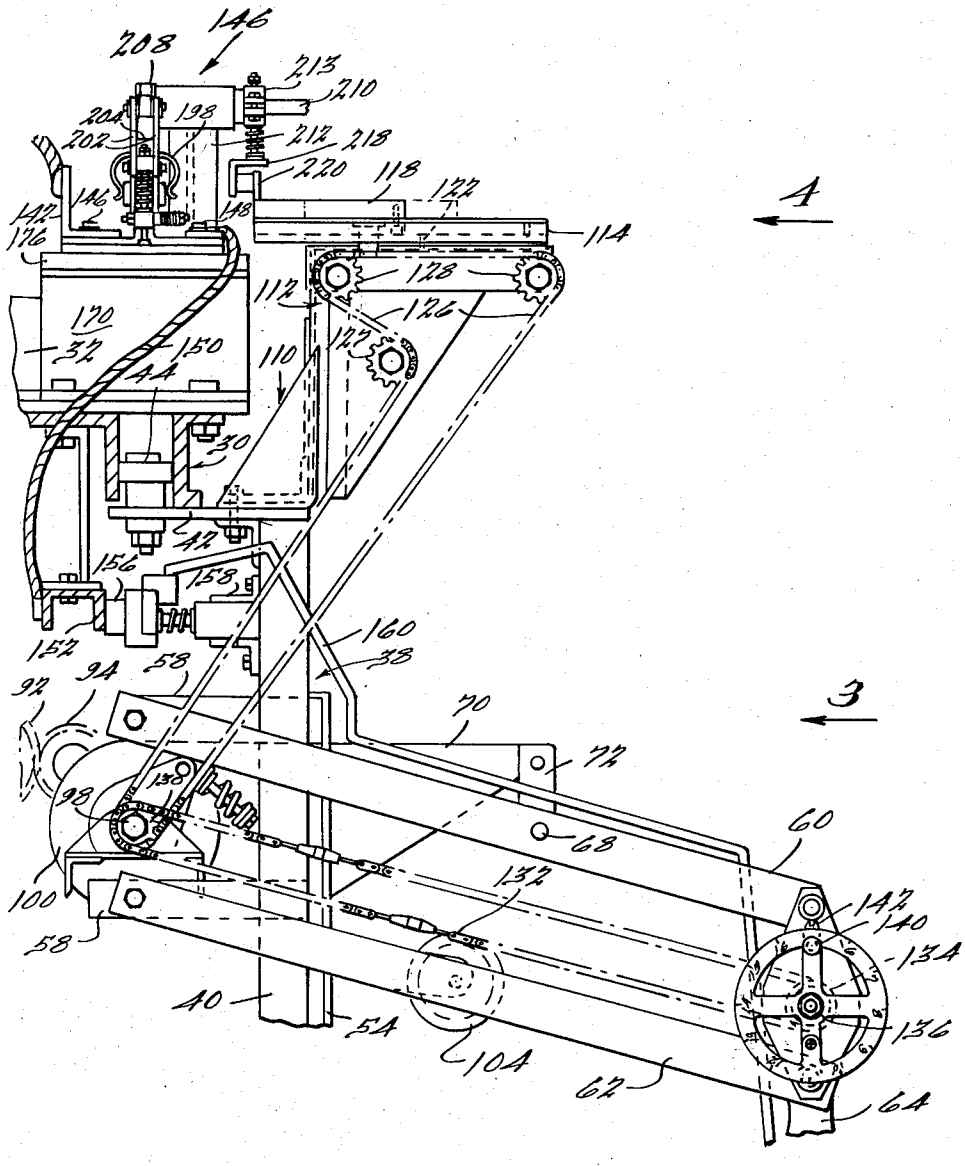


Fig. 2.

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SELECTIVE PLATING APPARATUS

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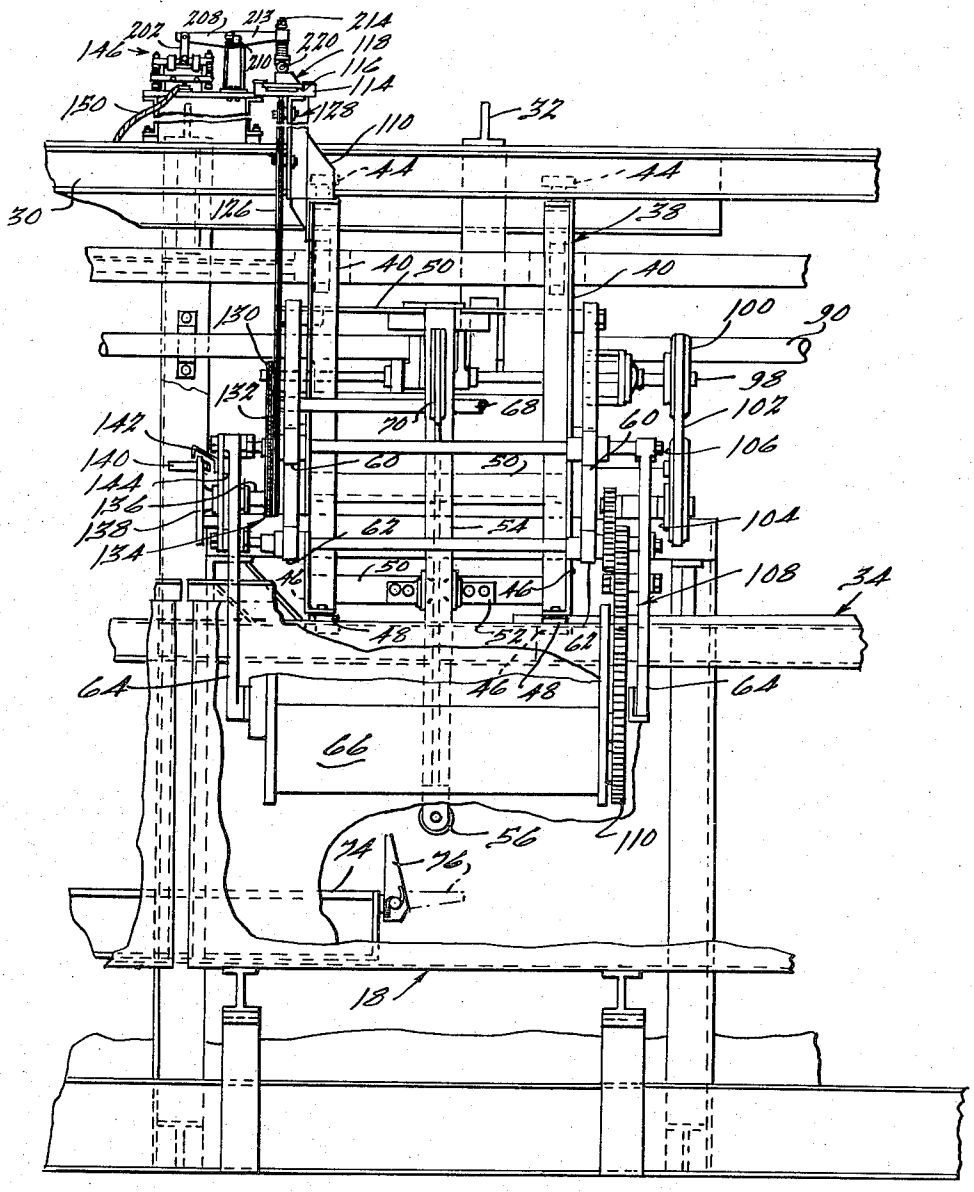


FIG. 3.

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SELECTIVE PLATING APPARATUS

Filed May 3, 1956 6 Sheets-Sheet 4

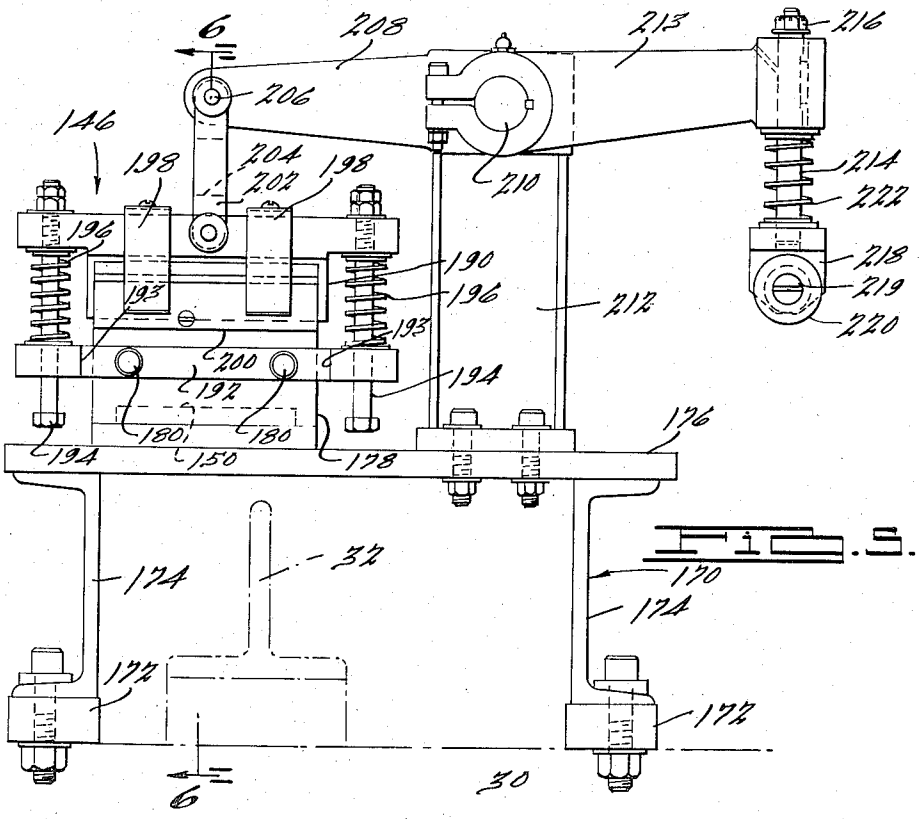


FIG. 5.

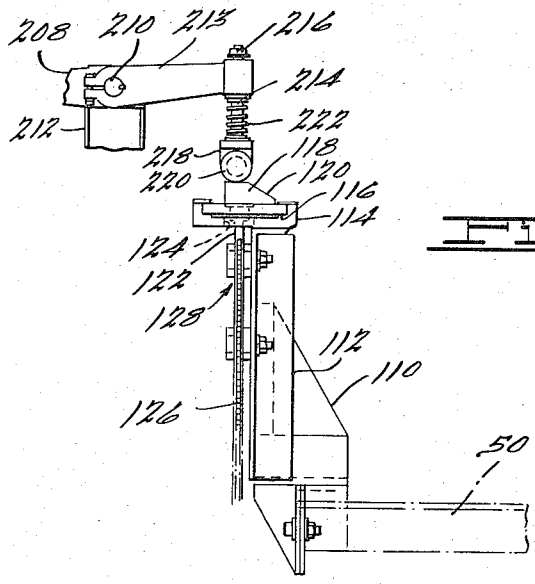


FIG. 4.

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SELECTIVE PLATING APPARATUS

Filed May 3, 1956 6 Sheets-Sheet 5

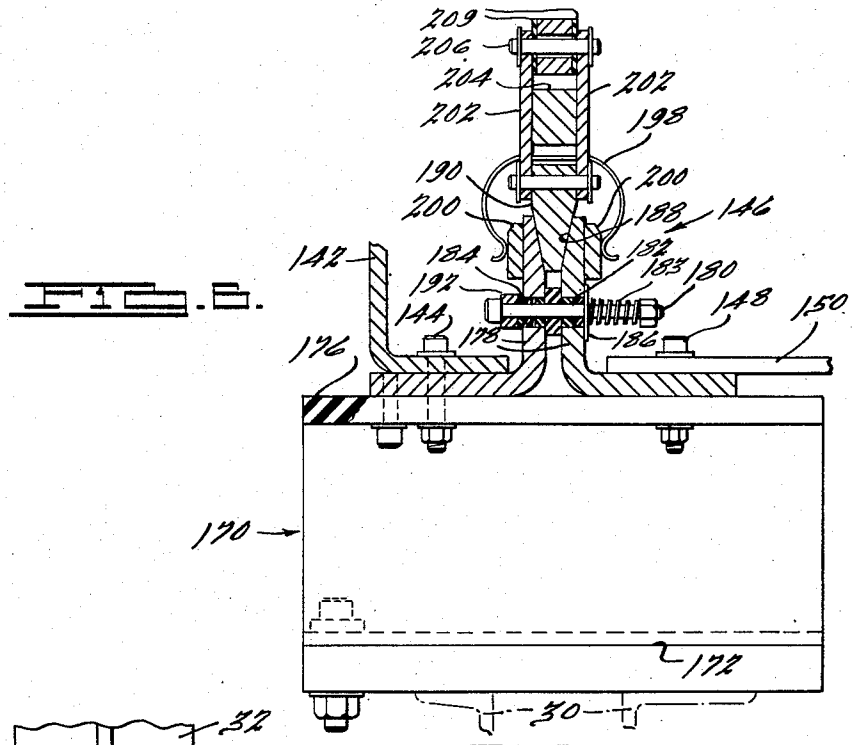


FIG. 6.

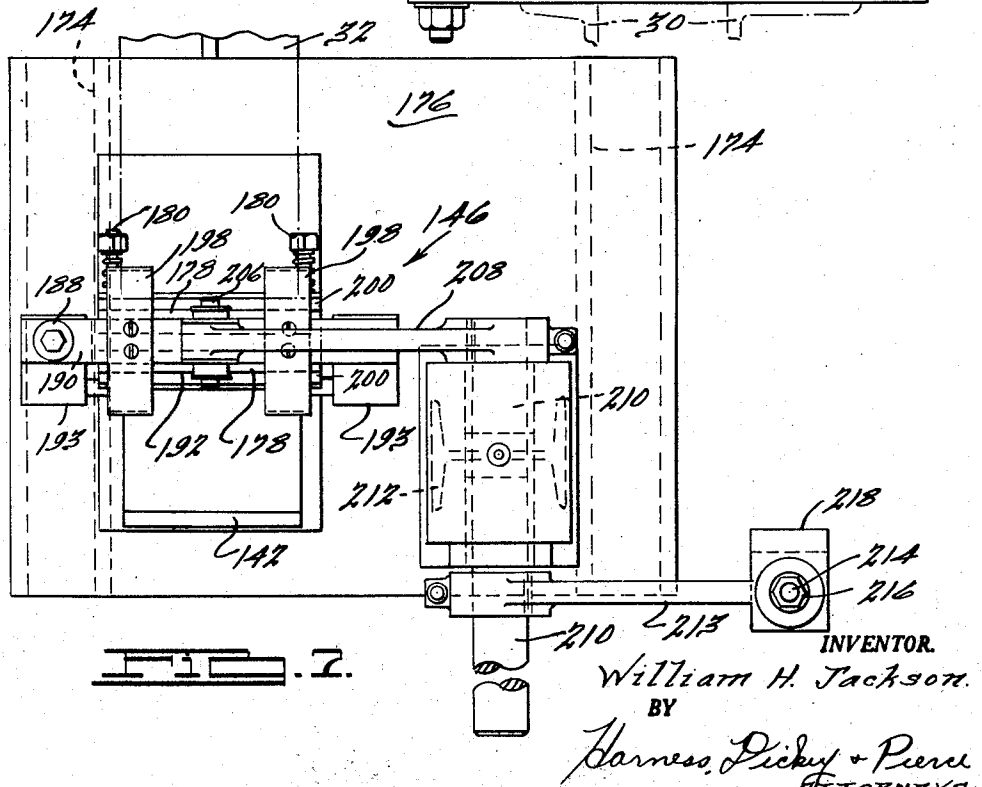


FIG. 7.

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SELECTIVE PLATING APPARATUS

Filed May 3, 1956 6 Sheets-Sheet 6

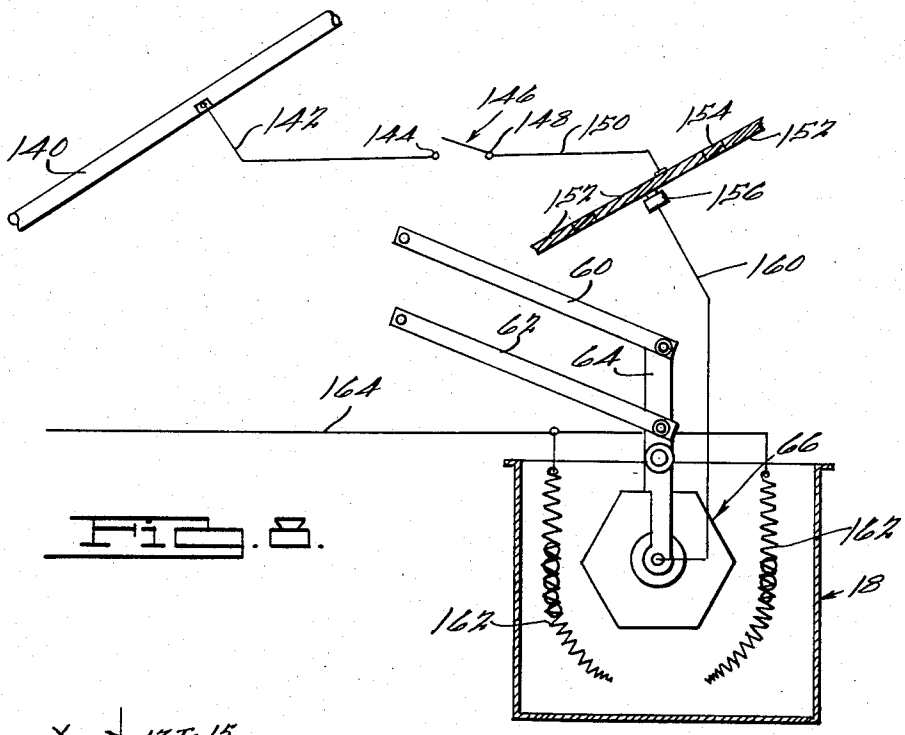


Fig. 8.

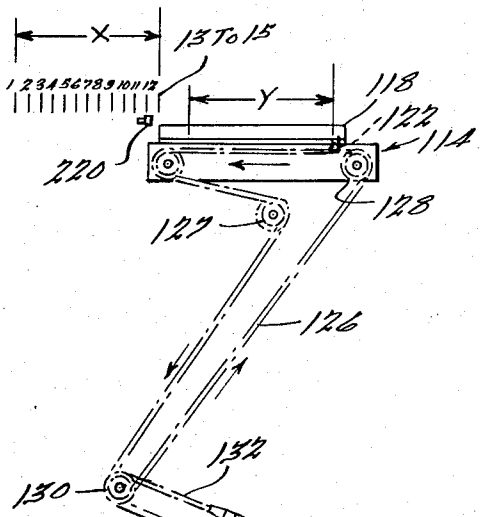
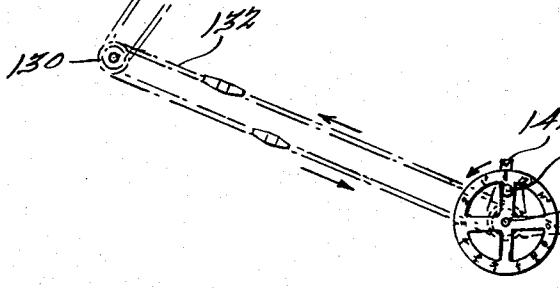


Fig. 9.



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United States Patent Office 2,924,564 Patented Feb. 9, 1960

2,924,564

SELECTIVE PLATING APPARATUS

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Application May 3, 1956, Serial No. 582,426

8 Claims. (Cl. 204—204)

The present invention relates generally to apparatus for the electrolytic treatment of articles. More specifically, the invention relates to a selective plating apparatus having a more convenient means for obtaining a desired thickness of metal plated on the work.

In the plating of metals the thickness of metal deposited in a given interval on a metal surface immersed in a plating bath usually cannot be readily varied by changing the current density and other operating conditions without impairing the quality of the coating. For this reason, variations in coating thickness must generally be obtained by varying the time of plating. In automatic types of plating machines it is not always possible, to obtain as wide a variation in the time of immersion as is sometimes required. While it is usually possible to readjust the machine to a new time cycle, this is impractical or impossible with most machines when successive loads of work simultaneously progressing therethrough require widely varying times of immersion in the plating bath.

The latter problem is often encountered in bulk plating wherein barrel or basket loads each containing a multitude of small articles are passed through the machine. In commercial use, it is often desirable to be able to process successive barrel loads of small articles which not only vary widely in size, shape and total surface area per unit of weight but also which may require differing thickness of plated material. Heretofore, automatic machines have not been satisfactory in the handling of this type of job lot plating and it has been the custom in many plating shops to have auxiliary batch style equipment available to do this type of work. It would be desirable to have an automatic machine in which there could be applied with equal facility the same thickness of plating to work having widely varying surface area per unit weight or widely differing thicknesses of plating to identical parts.

An automatic type of bulk plating machine is disclosed in my copending application, Serial No. 448,084, filed August 5, 1954, wherein a plurality of horizontal, rotatable plating barrels are each suspended on an individual carriage by a set of pantograph suspension arms. The carriages conduct the barrels through a series of treating stations, the pantograph arms permitting the barrels to be raised and lowered as required to pass over tank walls and to be rotated in both upper and lower positions where necessary. The machine of the copending application incorporates early-lift and/or delayed set-down means at some of its stations, the latter means being utilized to effect a reduction in the immersion time (as compared to the standard machine cycle) for the barrels in those stations. These early lift and delayed set-down means are controlled by the automatic machine controls circuit so that it is not easy to utilize them to effect variations in immersion times for individual barrels.

It is among the objects of this invention, therefore, to provide an apparatus for electroplating or other types of liquid treatments wherein means are provided for more conveniently varying the thickness of plating or coating.

Another object is to provide an automatic apparatus for the plating of work wherein work of widely varying surface area per unit of weight may be given the desired thickness of metal plating without disturbing the basic automatic machine time cycle.

Another object is to provide an automatic plating machine wherein means are provided, which are brought into operation by movement of the work, for selectively energizing a greater or lesser portion of a plating section in order to secure variation in the time that each load of work is exposed to the effects of the electric current.

Still another object is to provide an automatic plating machine wherein each work-supporting device such as a carriage is provided with a calibrated selector mechanism to enable the operator to set the time of exposure to the current which the work on such carriage will receive in its traverse of the machine.

Yet another object is to provide an automatic plating machine wherein a plating section or station is provided which contains a plurality of serially-arranged, separately-electrified plating positions and means are provided for automatically energizing or de-energizing a required number of such positions as the work progresses through the plating station.

It is also an object of this invention to provide a barrel-type bulk plating machine of the automatic type wherein the work is contained in barrels mounted on carriages and is moved through a plating station comprising a plurality of serially-arranged plating positions or cells, a number of such plating positions, which are in consecutive order, being provided with a separate circuit establishing means including a means to energize and de-energize the circuit and each barrel carriage being provided with an adjustable device that can be positioned to energize a desired number of the position circuits in the course of the travel of the carriage through the succession of plating positions.

Other objects and advantages will be apparent, or will become apparent, in the following more detailed description of the invention taken in conjunction with the accompanying drawings.

In the drawings:

Figure 1 is a plan view of the machine of this invention, partly schematic, showing an illustrative arrangement of the tanks and the manner in which a plurality of work-containing barrels are conducted through the machine;

Fig. 1A is a schematic plan view of the machine, as viewed in Fig. 1, showing an illustrative alignment, spacing and positioning of the switch rollers for normally-open switches;

Fig. 2 is an enlarged side view more clearly showing the barrel suspension arms, a switch actuator cam on the carriage, a drive unit for the cam mounted on the arms, and the individual position switch mounted atop the machine frame;

Fig. 3 is a front view of one station of the machine, the view being taken as if looking in the direction of the arrow 3 in Fig. 2;

Fig. 4 is an enlarged front view looking at the outer end of the carriage cam and its mounting and more clearly showing the manner in which the carriage cam engages the roller-equipped switch push rod, this view being taken in the direction of the arrow 4 of Fig. 2;

Fig. 5 is an enlarged front view of the position switch which is provided for each of the individually-energized plating positions in the plating section;

Fig. 6 is a sectional view taken vertically through the switch along the line 6—6 of Fig. 5;

Fig. 7 is a plan view of the switch of Figs. 5 and 6;

Fig. 8 is a schematic representation of the individual electrical circuit provided for each of the individually-electrified plating positions in the plating section or station; and

Fig. 9 is a representation, partly schematic, of the manner of operation of the calibrated cam drive unit and of the manner and order in which the switches or their roller-equipped arms are arranged or aligned along the side of the machine and the manner in which they are spaced across the zone of cam movement when using normally-open switches.

In accordance with the present invention a selective machine for plating or other electrolytic treatment of work is provided having an electrifiable section, such as a plating station, comprising a succession of serially-arranged liquid-treating positions through which the work is moved. Such liquid-treating positions each have a circuit means for applying an electric current to or across the work therein. The circuit means of each of a number of such liquid-treating or plating positions which are in consecutive order are arranged to be separately energizable by being provided with a switch, circuit-breaker, or other make-and-break means capable of establishing and interrupting the flow of the electric current. All such positions could be provided for in this way, if desired. In the machine of this invention the work is carried by, or supported from, a work-carrying means such as a carriage, carrier, a traveling arm or arms, racks, etc., or other members, which carrier means is mounted for travel through each of the above-mentioned succession of liquid-treating positions.

The machine of this invention also is provided with a means for selectively energizing and/or de-energizing a desired number of the individually energizable liquid-treating or plating positions in order to obtain a desired total time of exposure to the current (or total thickness of deposit) for each piece of work. This selective means is preferably mounted on or associated with each work carrier device and is so arranged that it is effective to selectively energize the individually energizable plating positions in response to, or in the course of, the movement of the work carrier through the succession of positions. The selective means preferably comprises a moveable or adjustable member for each carrier which is moveable in a given zone relative to the path of travel of the work carriers and which can be positioned in such zone so as to engage and actuate a predetermined number of the make-and-break means of the various individually-energizable plating positions. The selective means for each carrier also may include a calibrating means such as a calibrated drive unit for moving and positioning the moveable carrier member. The machine, of course, may also include, in addition to the electrifiable section or plating station, a number of other types of liquid-treating stations arranged to pre-treat or post-finish the work.

The selective means of this invention for controlling or determining the time of exposure of the work to the effects of the electric current is especially well adapted to bulk plating, and will be described more particularly herein in connection with the rotating-barrel type of automatic bulk plating machine, although it is to be appreciated that it is equally applicable to other types of plating machines such as the semi-automatic or automatic plating machines wherein traveling racks, frames, arms, carriers, etc. are used to support and carry the work through the machine.

Referring now to the drawings, the machine illustrated therein is of the horizontal, rotating-barrel type. For a complete description of such a machine reference should be had to my above-mentioned copending application. Before proceeding to describe the selective plating means of this invention, however, it is believed a brief description of the general construction and mode of operation of the basic machine will provide a better understanding of the present invention. As shown in Fig. 1, the machine is of the return type having a plurality of tanks arranged around a central frame. For purposes of illustration, the unloading and loading stations are located, respectively, at U and L in the upper right-hand corner of the machine, as viewed in Fig. 1, and the work travels around the machine in the direction of the arrows.

When used for a cyanide zinc plating process, for example, the upper reach (Fig. 1) of the machine may also contain a cleaning section **10**, which may consist of one or more individual tanks or stations which neutralize, clean and rinse the work, a pickle tank **12**, a rinse tank **14** and a cyanide dip tank **16**. The curved tank or station **18** extending around the left-hand end and along the bottom reach of the machine is an elongated plating station containing a plurality of serially-arranged plating positions **20**. Tank **18** can be any length corresponding to any multiple of the single celled positions **20**. The remaining section **22** of the machine will contain individual tanks for a drain tank, a cold water rinse, a bright (acid) dip tank, another cold water rinse tank and on the curved right-hand end a final hot water rinse tank **24**. Not all these tanks or stations are illustrated in detail since we are concerned here with only the electrified plating station **18** and the individual plating positions **20** thereof.

As shown in Figs. 1 and 2, an upper guide track **30**, consisting of a channel and an angle, is secured to the upper transverse central frame members **32**. Likewise, a lower guide track **34** composed of a channel and an angle, are secured to lower transverse frame members **36**. The guide tracks **30**, **34** extend completely around the machine and serve to guide a plurality of vertical carriage units or frames **38** around the machine. The carriage frames (Figs. 2 and 3) are made up of two vertical members **40** each having on their top ends a bracket **42** on which is mounted a roller **44** which is received between the members of the upper guide track **30** and, on their lower ends, a similar bracket **46** in which is mounted a roller **48** which is received in a similar fashion in the lower guide track **34**. The actual weight of the carriages is borne by the lower brackets **46** wrich rest on the channel edge of the lower guide tracks **34** and gibs are provided to prevent up and down movement of the carriages. The vertical carriage frame members **40** are cross braced by three horizontal members **50**. Mounted in roller brackets **52** in the middle of the upper and lower members **50** is a single, vertical lift leg **54** having a roller **56** on its lower end. Pivotally secured to pairs of inwardly-projecting brackets **58** rigidly secured near the top of the frame **38** are an upper pair **60** and a lower pair **62** of pantograph suspension arms which project out over the tanks. Connecting the outer ends of each pair of upper and lower arms **60**, **62** is a vertically-disposed barrel support hanger arm **64**. A hexagonal-shaped plating barrel **66** is rotatably suspended between the hanger arms **64**. At the top end of the lift leg **54** there is secured an outwardly projecting clevis bracket **70** in which is pivotally secured a link **72**. The lower end of the latter is pivotally secured to a rod **68** extended across between the upper pantograph arms **60**.

The lift leg **54** is raised by an elevator rail **74** suspended along each side of the machine opposite that portion of the machine wherein lifting of the barrels is required. As shown in Fig. 1, the rail **74** begins at the exit end of tank or station **18** and extends around the machine to terminate at the entrance end of tank or station **18**. Spring-loaded or weighted pick-up and drop-off fingers **76** are provided to engage and disengage the lift leg rollers **56** during the movement of the barrels. The rail **74** is lifted by a mechanism more clearly described in the above-mentioned copending application. When the lift legs **54** are lifted by the elevator rail **74**, the arms **60**, **62** of each carriage **38** are raised lifting the barrels **66** out of the tanks on an arcuate path. Since there is no lift rail and no tank walls in the elongated plating tank **18**,

the barrels therein remain immersed and are advanced while so immersed until their carriage lift legs **54** are picked up again by the elevator rail fingers **76**. If desired, however, the tank **18** could be made up of one or more individual tanks. The carriages **38** are moved around the machine in a succession of movements by a conveyor chain, a guide rail or plurality of sprockets **88** (Fig. 1) being provided to carry the chain around the curved ends of the machine.

As shown in Fig. 3 a lineshaft **90** mounted along each side of the machine has gears **92** mounted on it at intervals opposite each station requiring barrel rotation. The bracket members **58** carried by each carriage **38** have mounted thereon a spring biased gear **94** which meshes with the lineshaft gears **92** and with a fixed gear carried by a short shaft **98** mounted on the brackets **58**. The belt **102** is trained over an idler pulley **104** on one of the lower pantograph arms **62** and over a large pulley **100** carried in the upper end of one of the barrel hanger arms **64**. The pulley **106** actuates a gear train **108** carried on the barrel hanger arm **64** and terminating in a large ring gear **110** secured to the end of the barrel **66**. Rotation of the lineshafts **90** thus causes the barrels to rotate at all times in both upper and lower positions.

With the above brief description of the machine and its operation in mind, refer again to Figs. 2, 3 and 4. As will be seen best in Fig. 2, an upstanding gusset-type bracket **110** is bolted on the top end of the vertical carriage frame member **40** and over the upper roller support bracket **42**. To the bracket **110** a second, triangular-shaped, outwardly projecting bracket **112** is secured by welding and having secured on its upper horizontal leg a slideway **114**. In the latter there is fitted a slide member **116** having secured or screwed to its upper surface an elongated cam member **118** having its leading edge **120** (Fig. 4) tapered at about a 30 degree angle. As will appear most clearly in Fig. 4, the slide member **116** is driven by a drive unit comprising a system of chains and sprockets and a calibrated dial or turning wheel. The slide member **116** has a bolt, pin or finger **122** projecting downwardly through a longitudinal slot **124** in the bottom of slideway member **114**. The lower end of finger **122** is secured between the plates of a small plate-link type upper drive chain **126**, it being secured therein by several of the chain connector pins. Chain **126** is trained over an idler sprocket **127** and drive sprockets **128** mounted in the face of the outwardly projecting bracket **112**. As the chain **126** is driven forwardly and backwardly the slide **116** and cam **118** will be moved correspondingly in slideway **114**. The pin **122**, however, limits the movement of the slide **116** by engaging the sprockets **128**. It should be noted that since the cams **118** and their slideways are mounted on the carriages **38** which do not move up and down, the selector mechanism is effective irrespective of the vertical movement of the barrels **66** when they are lifted to clear tank walls.

The chain **126** is brought down over idler pulley **127** to pass around one face of a double-faced sprocket **130** mounted for free rotation on the end of shaft **98** of the barrel rotate mechanism. A second similar chain **132** is trained over the other face of sprocket **130** and is extended down alongside the suspension arms **60**, **62** to pass over a small sprocket **134** (Figs. 2 and 3) secured on the inner end of a short shaft **136** mounted through the left-hand barrel hanger arm **64**. On the outer end of shaft **136** (as viewed in Fig. 2) there is fixed a dial or turning wheel **138** having a handle **140**. A spring clip type of fixed pointer **142** is secured to a backing plate or bracket **144** (Fig. 3) rigidly bolted to the barrel hanger arm **64** and extends down over the edge of the dial to indicate its position. Thus, when the handle **140** is moved to rotate the dial **138**, shaft **136** turns sprocket **134** and drives the lower chain **132**. Sprocket **130** then rotates, driving upper chain **126** causing the slide member **116** and cam **118** to be advanced or retracted in slideway **114**.

As mentioned above, each of the plating positions **20** in plating tank **18** is provided with an electrical circuit and some of the positions are arranged to be individually energizable by means of an individual circuit, the components of which appear most clearly in Fig. 8. Along the top of the machine there is provided a main electrical input cable **140** from which a short branch lead **142** is led over to the input terminal **144** of a circuit breaker type of switch **146** located adjacent each plating position **20**. More will be said about the structure of the latter switch below. From the output terminal **148** of the switch **146** a second short lead **150** is extended down to be connected to a cathode bus bar section **152**. As appears most clearly in Fig. 8, a plurality of the bus bar sections **152** are secured together by insulating connectors **154**, with such a bus bar section being provided at each separately energizable plating position **20**.

A spring-loaded cathode contact shoe **156** (Fig. 2) is mounted on a bracket **158** carried on the inner side of each carriage unit **38** so as to be in contact with the bus bar sections **152**. Leading from the cathode contact shoe **156** there is provided cable **160**, which is supported on the barrel suspension arms **60**, **64** and extends down to pass into the interior of the barrel **66** where it is connected to the usual internal barrel type cathodes in contact with the work contained therein. At each of the plating positions **20** helically coiled anode electrodes **162** are secured and filled with balls of zinc metal or other metal being plated. The circuit is completed by an anode bus **164** connecting the anodes with the main power input cable **140**.

Since the amperage of the current carried by each of the above described plating position circuits is heavy, the switch **146** is of necessarily rugged design and incorporates arc suppressors. As will be seen in Figs. 2, 3 and 6, the switch is mounted on a heavy box-like metal base or bracket **170** mounted astride one of the upper transverse central frame members **32** and comprising adjusting spacers **172** (for vertical height) and side channels **174** secured across the upper guide track members **30**. Secured across the channels **174** is an upper base plate member **176** of insulating material. The switch **146** is shown to include two elongated, angle-shaped lower contact members **178** of copper secured by bolts to the insulating base plate **176** and resiliently bound together against spreading by several bolts **180**, each of which is passed through the contacts through an insulating bushing **182**, a spring **183**, an insulating pad **184** and an insulating washer **186**. The inner faces **188** of the upper ends of the lower contact members **178** are cut on a taper to resiliently receive therebetween a similarly tapered knife blade upper contact **190**.

The bolts **180** also secure a plate **192** against the insulating pad **184**. The plate **192** has on each of its ends an enlarged, rectangular portion **193** through each of which is passed a guide bolt **194**. Secured over the guide bolts **194** is the knife blade contact member **190**. A coiled compression spring **196** is disposed around each of the guide bolts **194** between the plate **192** and the blade member so as normally to urge the knife blade **190** out of contact with the lower contacts **178**. Several curved, spring type arc suppressor clips **198** of metal, such as beryllium copper, are secured over the upper edge of the knife blade **190** with their lower spring-like ends making contact with a plate-like arc brush **200** secured to each lower contact. Thus, when the upper knife blade **190** is drawn out of contact with the lower contacts **178** the spring clips remain in contact with the brushes **200** and conduct the current until the knife blade is fully withdrawn. The clip-like ends of the resilient arc suppressor clips **198** then quickly snap out of contact with the brushes **200** and effect a cleaner break of the circuit.

The knife blade upper contact **190**, supported by the springs **196** is pivotally secured between a pair of links **202** having a spreader **204**. The upper ends of the links **202** are

secured on a pin 206 passed through the end of a pivoted rocker arm 208. The arm 208 is insulated from the links 202 by means of insulating washers 209. The other end of rocker arm 208 is keyed to the inner end of a rocker shaft 210 supported in a separate support bracket 212 which is mounted near the outer edge of the insulating base plate 176. As seen in Figs. 2, 3 and 7, the rocker shaft 210 extends outwardly toward the tanks. To the outer end of shaft 210 there is secured a second rocker arm 213 which extends parallel to the path of travel of the carriages 38. On its other end, rocker arm 213 carries a vertical rod 214 slidably secured therein by a nut and cotter key 216. On the lower end of rod 214 there is secured an angle-shaped bracket 218 in which is secured, by means of a shoulder screw 219, a roller 220. A compression spring 222 is mounted around the rod 214 between the rocker arm 213 and the roller mounting bracket 218 so as to normally urge the roller 220 in a downwardly direction. As shown in Fig. 4 the roller 220 makes contact with the tapered leading edge 120 of the switch-engaging cam 118 so that the roller will be lifted vertically. As it does so, the spring 222 is compressed until rocker arm 213 is caused to pivot upwardly rotating rocker shaft 210. Rotation of the rocker shaft 210 causes rocker arm 208 to pivot or rock downwardly, forcing the knife blade contact 190 down between lower contacts 178. This completes the circuit shown in Fig. 8 and energizes the plating position 20 with which the switch 146 is associated. As will be noted, the trailing edge of cam 118 is vertical so that as the carriage is moved past the roller 220 the spring 222 will cause the rod 214 to drop quickly, effecting a rapid opening of switch 146.

Operation

As was mentioned above, the plating section of the machine of this invention contains a plurality of individual plating positions 20, some of which are provided with a separate electrical circuit for electrifying the work. The plating barrels pass through all such stations but the work is plated only in those stations in which the circuits are energized. For reasons specified below, it is usually undesirable to pass freshly plated work through plating solutions with no current flowing. It is preferred, therefore, that the plating occur at the exit end of tank 18 and the de-energized plating positions, if any, occur at the entrance end of plating tank 18.

For convenience, therefore, one or more of the adjacent positions 20 near the exit end of tank 18 need not be provided with switches 146 or individual circuit means so that plating occurs on the work of each barrel as it passes therethrough. Thus, there is plated in these positions on each barrel of work a certain minimal thickness of deposit, which thickness will vary with the different types of work, for example, from 0.0001 to 0.001 inch in thickness. This minimal thickness of plating should preferably be less than is required for most work necessitating the energization of one or more additional immediately-preceding positions 20 to build the thickness of the coating to the desired value. For purposes of illustration, Figs. 1A and 9 of the drawings show that the last three positions 20 of plating tank 18 have been arranged to plate all the time so that the zero position of dial 138 (i.e. cam 118 fully retracted, Fig. 9) has been given the numbers 13–15. There are, therefore, twelve individually electrifiable positions 20 in the illustrated machine. These numbers are for purposes of illustration only and it should be realized that all of the plating positions can be individually electrified and that any proportion thereof may be arranged without switches so as to plate all work passing therethrough. A large plating machine of this type could have in a single plating section as many as 20, 25 or even a greater number of the individual plating positions 20, including as many as 10 or more positions arranged to plate all the time.

The reasons for using this type of setup is that the zinc and cadmium cyanide plating solutions have the power, when no current is flowing, to dissolve away a freshly-applied zinc or cadmium plating. The acidic plating solutions, such as those of copper, nickel, chromium and others, also react adversely on metal immersed therein with no current flowing, such as a tendency to etch a freshly plated deposit, to deposit a precipitation-type of coating of inferior quality on either the bare metal or the freshly plated surfaces, which coating interferes with adhesion of later coatings applied with current, or to passivate the bare metal or previously-applied plated coating so that tightly adherent plated coatings of the desired weight can not be subsequently applied. Bare metal, however, can be safely immersed in cyanide type solutions without current flow since the solution only has a tendency to clean the metal. The selective plating machine of this invention, therefore, is especially useful in connection with zinc and cadmium cyanide type plating solutions or with any other plating solution which does not exhibit the above adverse effects or which is inhibited against these effects.

One of the switches 146 is, therefore, located above or adjacent to each of the plating positions 20 which it is desired to energize or de-energize. In Figs. 1A and 9, the first twelve of the stations 20 are shown as being so provided (numbers 1 to 12 on dial 138). Each of vertical switch push rods 214 for these twelve positions is positioned on its rocker shaft 210 so as to project outwardly toward the carriages. They are arranged, however, in a more or less uniform stepwise or staggered spacing across the zone of travel X of the cam 118. This sort of spacing is shown diagrammatically in Figs. 1A and 9, the spacing appearing in Fig. 1A being exaggerated for purposes of illustration. The distance X of Fig. 9, of course, is the sum of the clearance distances required for the rollers 220 of the number of switches 146 employed. The distance Y is the stroke of the slide member 116 and, of course, must be substantially equivalent to the distance X. Distance X, therefore, is the zone through which the cam 118 must be movable in order to be capable of actuating all the switches. Fig. 1A shows that the switch roller 220 of the switch at the first plating position 20 at the entrance end of plating section 18 (No. 1) is positioned so as to be closest to the longitudinal centerline of the machine (or with relation to the carriages it is the greatest distance inwardly therefrom) and the switch roller 220 of the last individually-electrifiable position 20 (number 12) projects the greatest distance from the longitudinal centerline of the machine. This order is shown in Fig. 9 wherein the cam 118 is shown fully retracted so as to clear the roller 220 of position No. 12 (only the continuously-electrified positions 13 to 15 plating). In this position of the cam the dial 138 is shown in the zeroed position marked "13–15." If it is desired to electrify station 12, cam 118 would have to be advanced in toward the machine frame to engage the roller 220 of station 12. As dial 138 is turned in the direction indicated by the arrow so as to bring the numbers 12, 11, 10, etc. under the pointer 142, it will be seen that the chains move in the directions indicated to project the cam 118 inwardly of the machine into the zone of cam movement X. When the number (1) on dial 138 is under the pointer the drive pin 122 attached to slide member 116 engages the inner of sprockets 128 and it is necessary to reverse the rotation of the dial to retract the cam 118.

The above illustrated alignment of the switch push rods and their rollers is preferred for normally-open switches. When normally-closed switches are employed it is preferable that the staggered arrangement of the push rods 214 on the rocker shafts 210 be reversed, that is, the rod 214 of position No. 1 will project the greatest distance, and the rod of position No. 12 will project the least distance, from the longitudinal centerline of the

machine. Dial 138 could then be calibrated in reverse order to read directly in position numbers which will be plating (or not engaged by cam 118).

The utility of the plating machine of this invention will become more evident when it is seen that an operator stationed at loading station will load each barrel as it arrives from unloading station U. After he has loaded the barrel he will check the setting of dial 138 to see if a correct number of stations will be energized to plate the desired thickness of metal on the particular work he has just placed in the barrel. If not, he rotates the dial to the correct setting before the barrel moves on to the first of the plating positions in tank 18. Knowing the minimal thickness of coating plated on the work in the continuously-electrified positions 13 to 15 and the average increment added in each of the individually-electrifiable positions 20, it is a simple matter to compute the correct number of the stations 20 to be energized to yield the desired total thickness of coating. If all the plating positions 20 are individually energizable he, of course, needs only to know the average increment of plating thickness which will be deposited in each position. In commercial operations calibration curves or charts could be prepared of plating thickness versus number of stations for each general type of work.

Let it be supposed that each barrel is loaded with a given weight of work. When the individual pieces are small, for example, small screws or springs, etc., the total surface area to be plated represented by a given weight is relatively larger than when the same weight of larger articles such as stampings or heavy bolts, etc. are to be plated. If both types of work were immersed for the same length of time under the effects of current, the smaller articles would receive a thinner deposit than the larger. Likewise, it may be necessary in some cases to plate a much thicker deposit on one barrel of a given type of work than is required for the succeeding or preceding barrel of the same work. It can be seen, therefore, that the machine of this invention makes it possible to handle widely varying types of work and to plate on each type exactly the desired thickness of metal. The machine thus makes it possible for the plating shop to handle small job lot plating on an economical automatic basis. It is also valuable in handling large volume types of work, the advantage residing in not having to readjust the controls of the machine when changing from one type of work to another.

What is claimed is:

1. In an apparatus having a plurality of work-supporting means mounted for travel through a succession of liquid-treating positions, a circuit means for each of a number of said positions and each including an anode, an electric current source connected thereto and means for establishing and interrupting the flow of electric current between said anode and said work-supporting means, an engaging means for each said work-supporting means each mounted so as to be moveable in a given zone relative to the path of travel of said work-supporting means, said current establishing and interrupting means being arranged along the path of travel of said work supporting means and spaced in a stepwise manner across the zone of movement of said engaging means, and means on each said work supporting means for moving its respective engaging means to a position in said zone wherein it will actuate a predetermined number of said current establishing and interrupting means in response to the movement of said work-supporting means through said succession of liquid-treating positions.

2. In an apparatus having a plurality of work-supporting means mounted for travel through a succession of serially-arranged liquid-treating positions, a circuit means for each of a number of said stations and each including an anode, an electric current source connected to said anode, a switch means effective to establish and interrupt the flow of current from said anode to said work-supporting means, each said switch means having an actuable member located adjacent the path of travel of said work-supporting means, an engaging means mounted on each said work-supporting means so as to be moveable in a given zone relative to the path of travel of said work-supporting means, the said actuable members being arranged along said path of travel of said work-supporting means and spaced in a stepwise manner across the said zone of movement of said engaging means, and means on each said work-supporting means for moving its respective said engaging means to a position in said zone where it will engage a predetermined number of said actuable members in response to the movement of said work-supporting means through said plating positions.

3. In an apparatus having a plurality of work-supporting carriages mounted for travel through a succession of liquid-treating positions, an electrical circuit means for each of a number of said positions providing electric current to each said position and including, an electrical switch mounted adjacent each said position, each said switch being electrically connected, respectively, to the said circuit means of its said position so as to be effective in establishing and interrupting the flow of electric current therein, a switch engaging cam means mounted on each said carriage so as to be moveable in a given zone relative to the path of travel of said carriages, said switches of said positions being arranged along the path of travel of said carriage units in a stepwise manner so as to be each actuable at a given position in said zone of movement of said switch engaging cam means, and means on each said carriage for moving its respective said switch engaging cam means to a position wherein it will engage and actuate a pre-selected number of said switches in response to the movement of said carriage through said plating positions.

4. Apparatus comprising a plurality of serially-arranged liquid-treating stations including a plating station containing a plurality of serially-arranged plating positions, a plurality of work-supporting carriages mounted for travel through said stations, circuit means for each of said plating positions for subjecting the work therein to the action of an electric current including an anode, current supplying means connected to said anode and means connected to said carriages to complete said circuit, and a switch for each of at least a number of said plating positions which are in adjacent order starting from the entrance of said plating station and each effective to establish and interrupt the flow of said current in its respective circuit means, an engaging cam mounted on each said carriage and each moveable in a given zone relative to the path of travel of said carriages, an actuable member for each said switch positioned in said zone of cam movement, said actuable members being aligned, with respect to each other and to the direction of travel of said carriages, in a stepwise fashion across said zone of cam movement so that each said cam can engage and actuate at predetermined positions thereof a predetermined number of said actuable members.

5. In an apparatus having a plurality of work-supporting carriages mounted for travel through a succession of liquid-treating stations including a plating station containing a plurality of serially-arranged individual plating positions, a separate circuit means for each said plating position for applying an electric current to the work therein including an anode, and a current source connected to said anode, and an electric switch located at each said position and electrically-connected into the respective said circuit means so as to be effective to establish and interrupt the flow of said current, a switch-engaging cam mounted on each said carriage so as to be moveable in a given zone toward and away from said switches, an actuating arm on each said switch projecting into said zone of cam movement, the projecting ends of the said actuating arms being arranged, with respect to the path

of travel of said carriages, in a uniformly-spaced stepwise manner across said zone of cam movement, a cam drive unit associated with each said carriage for moving the respective said cam, and a calibrated means connected to said drive means to enable the positioning of each said cam so as to engage a predetermined number of said switch acuating arms as the carriage moves through said plating positions.

6. In an apparatus having a plurality of plating barrels each suspended from a carriage which is mounted for travel through a succession of liquid-treating stations, a plating station constituting one of said successive stations and containing a plurality of serially-arranged individual plating positions, circuit means for each said plating position including an anode, a current source connected to said anode, and an electrical switch located at each of a number of said plating positions which are in consecutive order starting at the entrance end of said plating station, each said switch being effective to establish and interrupt flow of electric current in the said circuit means of its said plating position, an engaging member mounted on each said carriage so as to be moveable in a given zone relative to the path of travel of said carriages, in actuable element for each said switch effective to open and close said switch, said actuable elements being arranged along the path of travel of said carriages and spaced in a graduated manner across the said zone of movement of said engaging members, and a drive means associated with each said barrel and its suspension for moving the engaging member thereof to a position in said zone where it will engage and actuate a predetermined number of said actuable elements as said barrel and its carriage travel through said plating positions.

7. Apparatus as defined in claim 6 wherein the said barrel is mounted on suspension arms, the said drive means comprises a system of chains trained over sprockets mounted on said suspension arms and said engaging means comprises a plate-like member mounted for movement in a slideway and arranged to be reciprocated by said drive means.

8. Apparatus as claimed in claim 5 wherein the said electrical switches are of the normally-open type and their said actuating arms are so arranged that on engagement by each of said engaging cams on said carriages the said switches will be closed to establish flow of current in said circuit means.

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