April 15, 1958 W. B. PLEADWELL 2,830,946

ELECTROPLATING APPARATUS

Filed Oct. 15, 1953 5 Sheets-Sheet 1

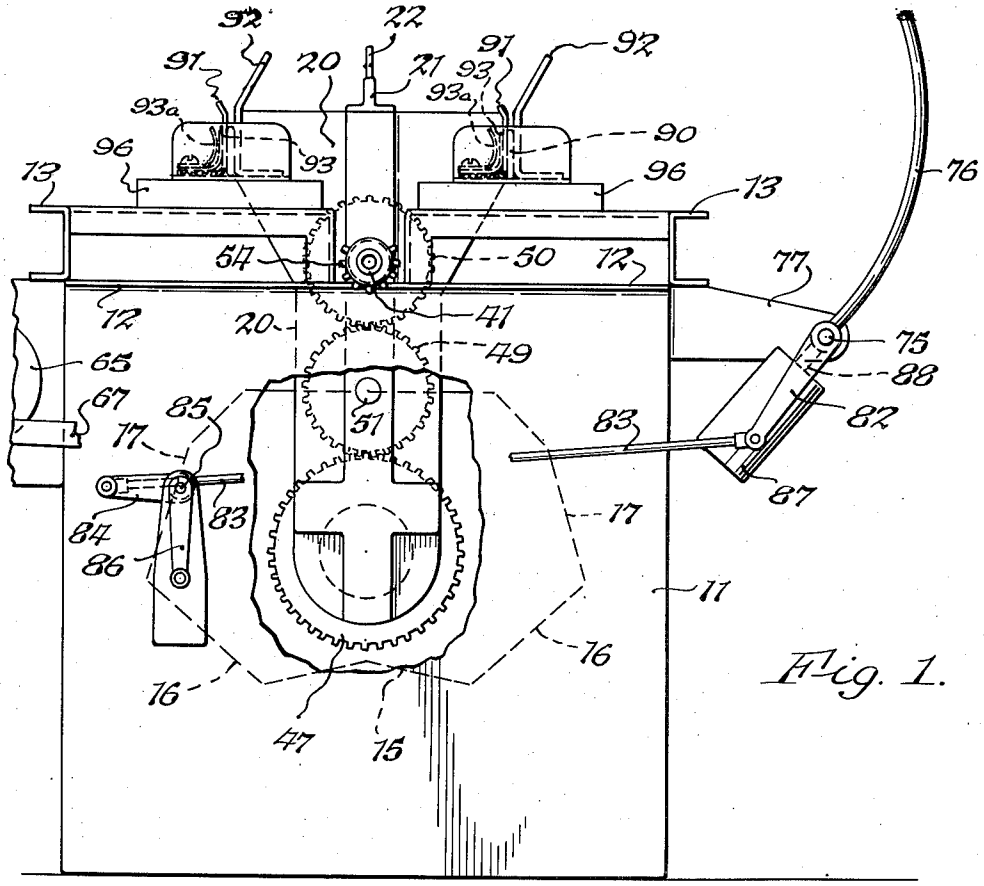


Fig. 1.

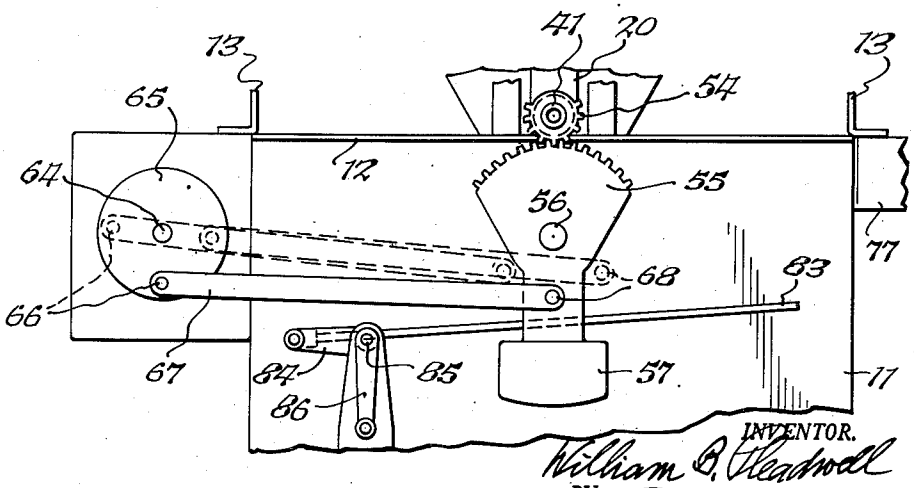


Fig. 2.

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ELECTROPLATING APPARATUS

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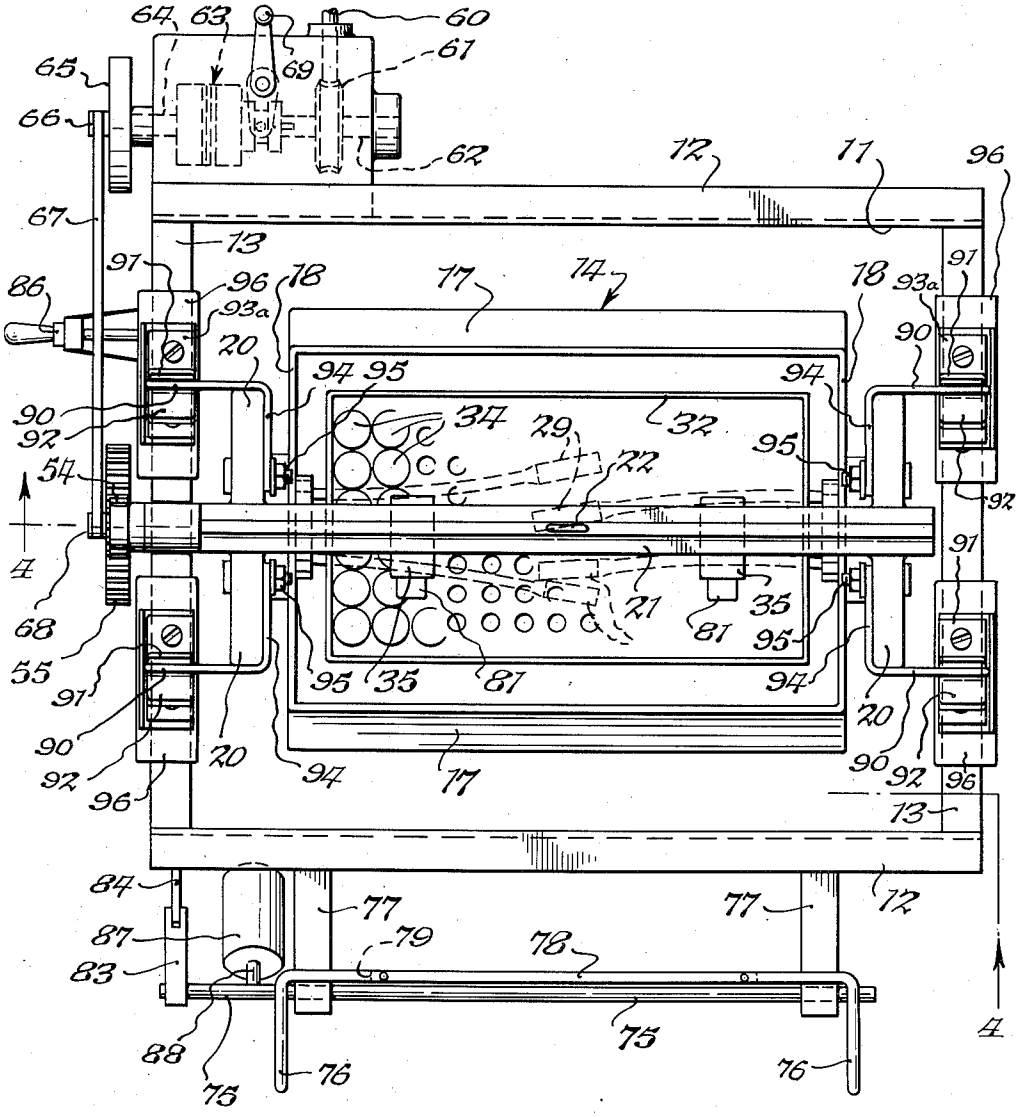


Fig. 3.

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Filed Oct. 15, 1953 5 Sheets-Sheet 3

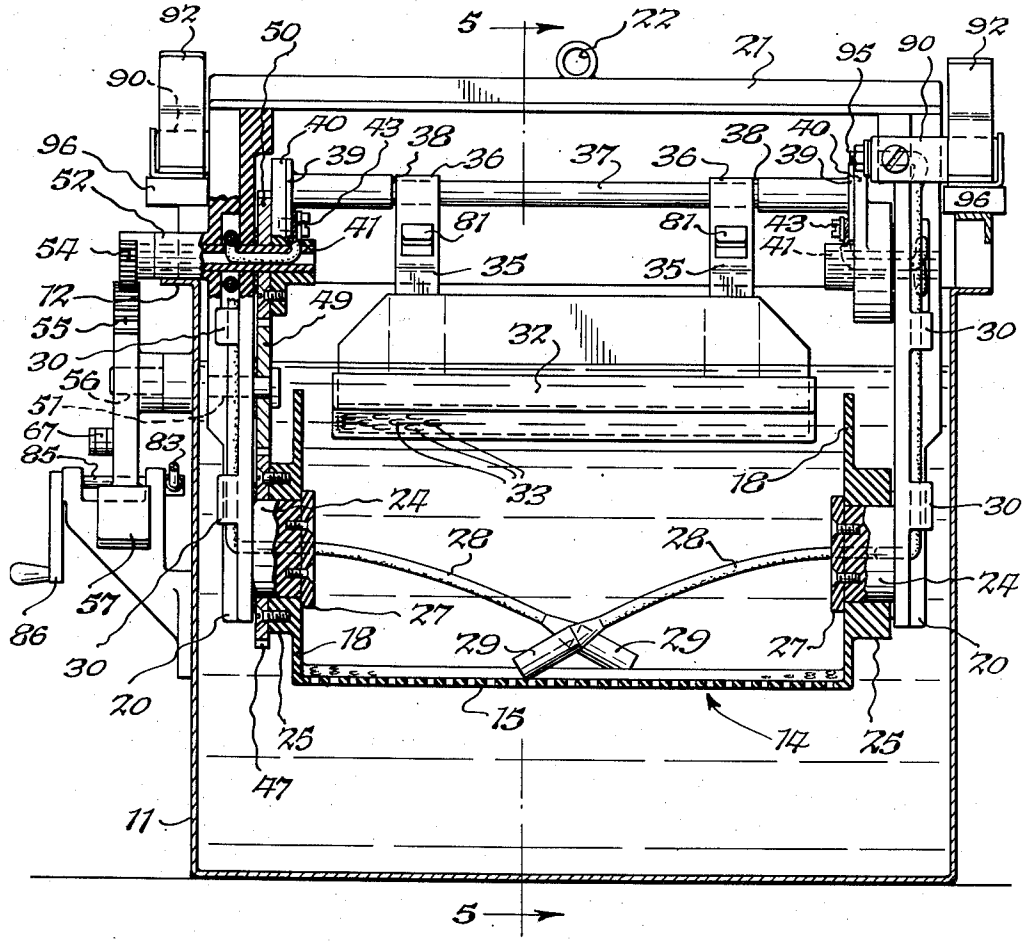


Fig. 4.

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ELECTROPLATING APPARATUS

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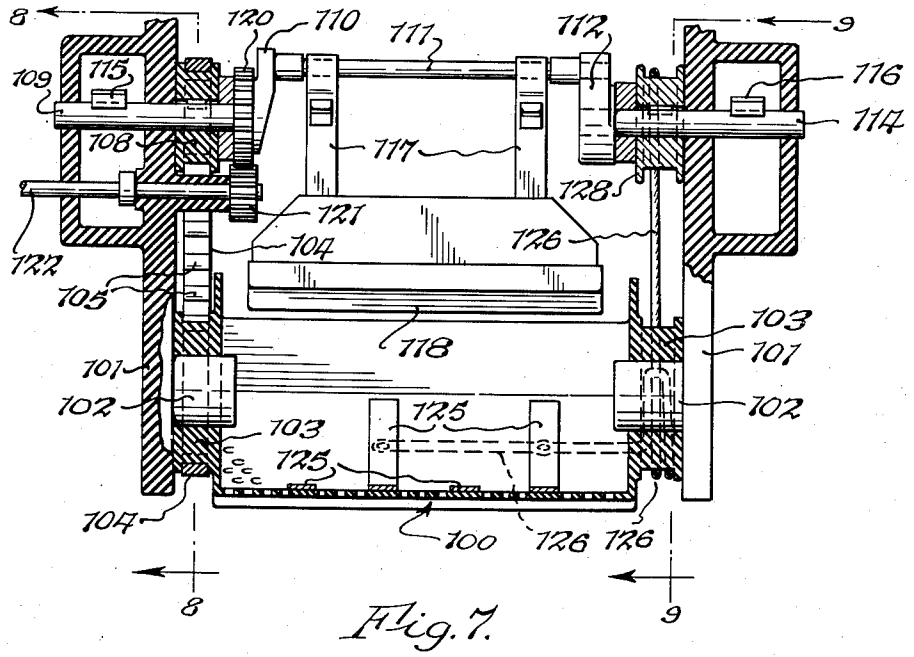


Fig. 7.

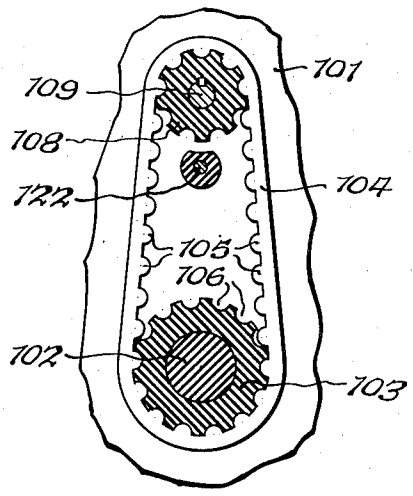


Fig. 8.

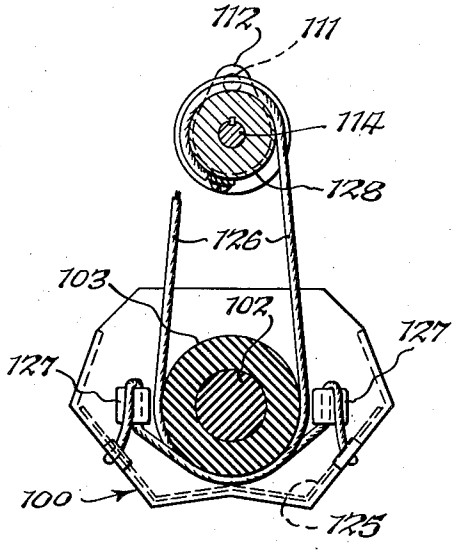


Fig. 9.

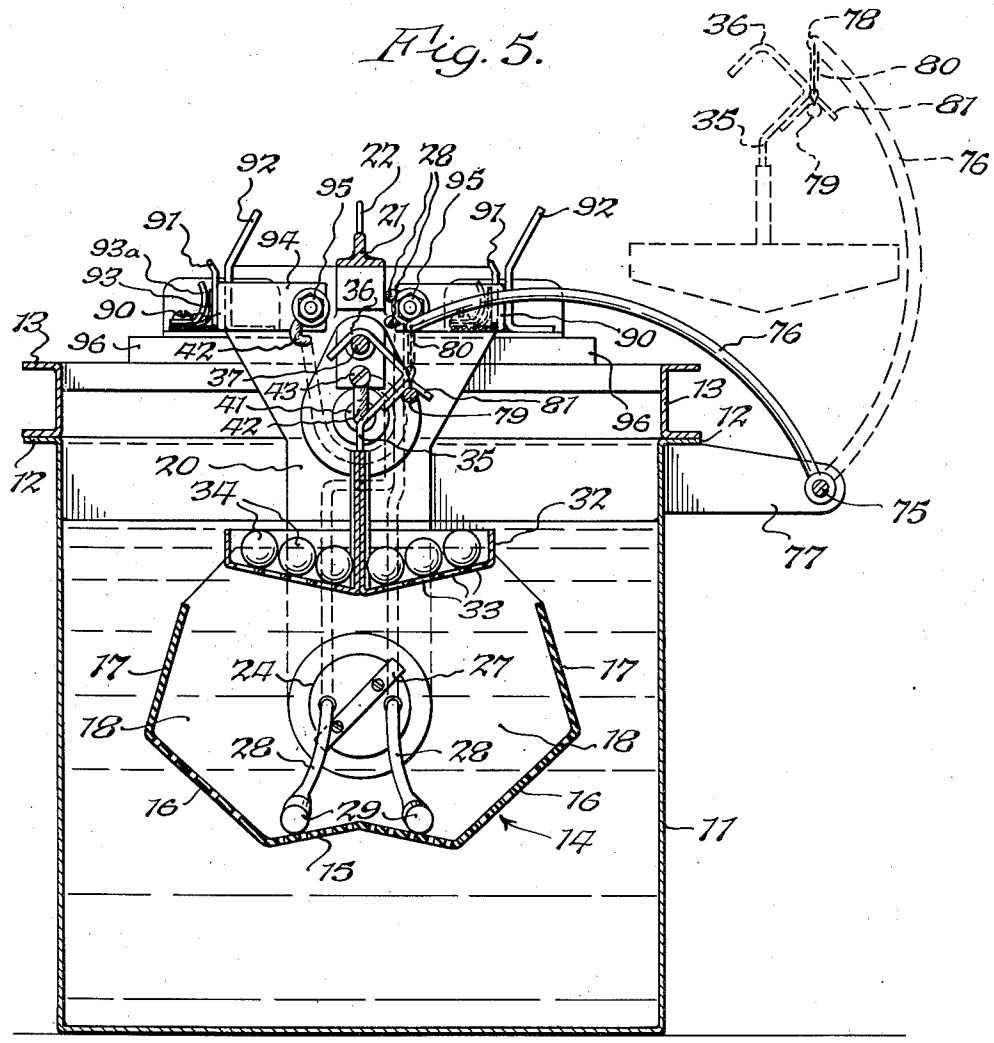
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ELECTROPLATING APPARATUS

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Fig. 5.



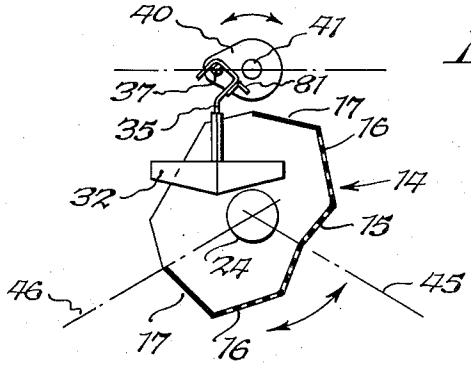


Fig. 6.

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2,830,946

ELECTROPLATING APPARATUS

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Application October 15, 1953, Serial No. 386,325

2 Claims. (Cl. 204—222)

This invention relates to improvements in electroplating apparatus of the bulk type in which the articles to be plated are placed loosely in a container for the same which is submerged in the electrolyte.

One of the objects of this invention is to provide a plating apparatus with an improved mounting for the anode basket realtive to the work or cathode basket, so that the basket will stay at substantially the same distance from the articles being plated during the movement of the work containing basket, so that the plating will continue at a substantially uniform rate during all positions of the work containing basket. Another object is to provide plating apparatus with an improved mounting for the anode basket so that the same may be readily removed from the apparatus to render the work accessible.

A further object is to provide a work containing or cathode basket of improved construction which is so mounted on the apparatus that it may be readily removed from the apparatus for dumping the work from the basket, and which when replaced in the apparatus will automatically connect electrical contacts in the circuits which conduct electricity to the electrolyte for effecting the plating. It is also an object to provide electrical connectors on the apparatus and on the work basket which serve the additional purpose of guiding the work basket in correct operative relation to the mechanism for oscillating the work basket. It is also an object of this invention to provide a drive for oscillating the work carrying basket and the anode and which is provided with means for automatically positioning the parts thereof so that when the work basket is replaced on a machine, the parts of the mechanism will be in correct relation to each other.

Other objects and advantages will be apparent from the following description of one embodiment of the invention and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:

Fig. 1 is a fragmentary side elevation of a plating apparatus embodying this invention, a part of the side wall being broken away to better show a portion of the interior construction.

Fig. 2 is a fragmentary side elevation of the upper portion thereof.

Fig. 3 is a top plan view thereof.

Fig. 4 is a longitudinal sectional elevation thereof, on line 4—4, Fig. 3.

Fig. 5 is a transverse sectional elevation thereof, on line 5—5, Fig. 4.

Fig. 6 is a diagrammatic fragmentary transverse sectional elevation of the apparatus on a reduced scale showing the work-receiving basket in an extreme position of its movement.

Fig. 7 is a transverse sectional elevation of a plating apparatus of modified construction.

Figs. 8 and 9 are respectively, sections thereof, on lines 8—8 and 9—9, Fig. 7.

11 represents a tank of any suitable or desired form or construction in which the eletcrolyte is contained, and in which the plating takes place, that shown being substantially of rectangular or box-like form and is provided at the upper edges thereof with outwardly extending flanges 12 on which parts of the apparatus may be supported. Channel-shaped reinforcing members or beams 13 may extend partly around the upper portion of the tank, preferably resting on the flanges 12.

14 represents a work-receiving basket which is of partly approximately polygonal transverse cross section, being provided with a bottom wall 15 extending throughout the length of the basket and preferably comprising two panels arranged at a re-entrant angle to each other. The bottom wall is provided at opposite sides thereof with upwardly and outwardly inclined longitudinally extending walls 16 which terminate at their upper edges in longitudinally extending upper walls 17 extending upwardly and inwardly toward each other from their juncture with the walls 16. The bottom walls 15 and the lower walls 16 are perforate so that the electrolyte may readily pass into and out of the perforations in these walls and the upper wall 17 may be imperforate, if desired. These longitudinally extending walls terminate at their ends in opposite end walls 18. This work-receiving basket may be made of any suitable or desired non-conducting material, such as commonly used in barrels or in work-receiving baskets on electroplating apparatus.

The work basket is pivoted at its opposite ends on a carrier frame comprising a pair of downwardly extending straps or supporting members 20 made of material which is a non-conductor of electricity and which is substantially inert with respect to the electrolyte employed. The upper ends of these straps are connected by a suitable frame member or bar 21, that shown having an eye 22 secured thereto intermediate of its ends, which may be engaged by a hook or other part of a hoisting device. The straps 20 are provided adjacent their lower ends with trunnions 24 extending toward each other and into bearing apertures formed in enlarged bosses 25 of the end walls 18 of the work basket. Bars 27 of slightly greater length than the diameter of the trunnions 24 are preferably secured to the inner ends of the trunnions for holding them in correct relation to the end walls of the work basket. The trunnions are provided with suitable openings or apertures therein through which current-conducting cables 28 may extend. These cables have metallic terminals or dangler ends 29 at the ends thereof, which terminals serve the purpose of conducting current to the work within the basket 14. The straps may be provided at intervals with lugs or projections 30 which hold the conductors 28 in place thereon.

The plating apparatus also includes an anode of any suitable type, that shown including a basket 32 made of any usual or suitable material and provided with openings or perforations therein, such for example as holes 33. The anode basket may contain anode material of any suitable or desired type. In the construction shown in Figs. 3 and 5, anode material 34 is in the form of balls. The anode basket has straps or supporting members 35 secured thereto and provided at the upper ends thereof with hook-shaped parts 36 which are formed to hook over a swinging anode rod 37 extending lengthwise of the apparatus. The anode basket as well as the straps 35 are made of metal to carry electric current to the anode material 34. The anode rod is preferably provided with shoulders 38 which prevent movement of the straps 35 lengthwise of this rod.

The opposite ends of the rod 37 are rigidly secured to rocker arms 39 also made of current-conducting material and which, in turn, are secured to similar shaped arms 40 made of insulating material and rigidly secured

to shafts 41 suitably journalled on the arms 20 of the carrier frame at a distance below the upper ends thereof. The shafts 41 are made of insulating material and are also preferably made hollow so that conductors 42 may extend partly through the same and through openings in the sides thereof for connection at 43 at the arm 39 from which the current may flow to the rod 37 and through the straps or hangers 35 to the anode basket 32. Any other means for supporting the anode from the rocker arms 39 may be provided in place of the rod 37.

In order to plate the work on all faces thereof in bulk plating apparatus, it is necessary to tumble the work in the work basket 14 in such a manner that different portions of each workpiece are presented to the electrolyte to receive metal therefrom. For this reason, the work basket is preferably constructed as shown with the bottom wall 15 positioned nearer to the axis of the bearings 24 than the walls 16, so that when the work basket oscillates, the work will tumble or cascade back and forth between the walls 15 and 16. It is also desirable to provide a work basket as described for the further purpose of providing at all times a fresh quantity of electrolyte within the basket and to discharge from the basket the electrolyte which has become impoverished of its metal. It is also desirable to swing the work basket through a relatively large angle about the trunnions 24, as illustrated in Fig. 6, which shows the basket in one of its extreme positions, in which the central vertical axis of the basket, represented by the line 45, would lie in the line 46. During such extreme movements of the work basket the work contained therein would at times be so far from the anode basket that very little plating would take place. I have, consequently, mounted the anode basket in such a manner that the anode basket is moved with relation to the work basket so that the anode will at all times be substantially equi-distant from the work being plated, so that no interruption of the intensity of the plating will occur. In the construction shown for this purpose, I arrange the rod 37 on which the anode basket hangs in such a manner that the same swings so that the anode basket will be maintained at substantially the same distance from the work in all positions of the work basket.

In the construction shown by way of example for rocking the work basket and swinging the anode basket, the work basket is provided at one side thereof with a gear 47 suitably secured to the enlarged boss 25 of one of the end walls 18 of the work basket. This gear meshes with an idler 49 which, in turn, meshes with a gear 50. The idler 49 may be rotatably mounted on a bearing pin 51 secured to one of the supporting straps 20. The gear 50 is rigidly secured to the arm 40 secured to the anode rod 37 and to the shaft 41, which is mounted in suitable bearings 52 which may rest on a part of the flange 12 at one end of the tank. On the outer end of the shaft 41 is secured a gear segment 54 arranged to mesh with a larger gear segment 55 rotatably mounted on a pivot bearing 56 secured to the end wall of the tank. The segment 55 has a downwardly extending arm provided at the lower end thereof with a weight 57, the purpose of which will be hereinafter explained.

In order to impart an oscillatory motion to the work basket 14 and a swinging motion to the rod 37, on which the anode basket hangs, the following mechanism may be provided:

A suitable motor (not shown) is preferably employed for this purpose which drives a worm shaft 60 which, in turn, meshes with a worm gear 61, Fig. 3. The gear 61 is rigidly secured on a shaft 62 which may be connected by means of a clutch 63 of any suitable or desired type with a shaft 64 on which a crank wheel 65 is secured, see also Fig. 2. This wheel has a crank pin 66 on which one end of a connecting rod 67 is pivoted, the other end of which is pivoted at 68 on the segment 55. Consequently, when the worm shaft 60 is rotated and the clutch 63 moved into engagement to connect the shaft 62 with the shaft 64 which may, for example, be effected manually by means of a clutch-actuating handle 69, the crank pin 66 acting through the connecting rod 67 will impart oscillatory motion to the gear segment 55 which, in turn, through the segment 54 rotates the shaft 41 alternately in opposite directions. This motion is transmitted to the gear 50 and through the idler 49 to the gear 47 which is secured to the work basket 14.

While the work basket is being swung as illustrated in Fig. 6, the rotation of the shaft 41 also imparts a swinging motion to the anode rod 37 on which the anode basket is suspended, because of the fact that the arm 40 is rigidly secured to the gear 50 and to the anode rod 37. Consequently, when the work basket is in the position shown in Fig. 6, the anode basket 32 is in approximately the position also shown in Fig. 6. When the work basket swings to the opposite limit of its movement, the shaft 41 and the arm 40 connected therewith swings through approximately half a circle which results in first raising the anode basket 32 and then again lowering the same into a position in which the rod 37 is to the right of the shaft 41. By alternately swinging the anode basket about half a circle while the work basket swings from one extreme position to the other, the anode basket will always be at approximately the same distance from the work in the work basket and approximately directly above the same, and consequently, an approximately uniform flow of current through the electrolyte and a substantially uniform rate of plating throughout the movement of the work basket results.

As has been stated, it is desirable to lift the work receiving basket 14 upwardly out of and away from the tank 11 to remove from this basket the plated material and to place into it additional material to be plated. Before this is done, however, it is desirable to remove the anode basket 32 from the plating apparatus. This may be done in any suitable or desired manner, and in the construction shown for this purpose in Figs. 1, 3 and 5, I preferably provide a shaft 75 rotatably arranged in arms or brackets 77 secured to the side of the tank. This shaft has a U-shaped member secured thereto, this U-shaped member comprising opposite legs 76, each welded or otherwise secured at one end to the shaft 75 and having their outer ends connected by a longitudinally extending connecting member 78. From the connecting member 78 is suspended a rod or shaft 79, Fig. 5, for example by means of short, flexible members or chains 80. The straps 35, by means of which the anode basket is suspended, are preferably provided with angle-shaped parts or hooks 81, see particularly Figs. 3 to 6, with which the rod or shaft 79 may engage, as shown in full lines in Fig. 5.

Means are provided for swinging the shaft 75 from the full line position shown in Fig. 5 into the dotted line position, and any suitable or desired means may be provided for this purpose. In the construction shown by way of example, the shaft 75 is provided with an arm 82 connected by means of a link 83 to a crank arm 84, secured to one end of a crank pin or pivot 85 rotatably mounted on a bracket mounted on a side of the tank. The other end of this shaft is provided with a hand crank 86, Figs. 1, 2 and 4. By turning the hand crank through a part of a revolution, the shaft 75 and U-shaped member may be swung into either of the two positions indicated in Fig. 5. In order to facilitate the lifting of the anode basket, a counterweight 87 is mounted on an arm 88 also secured on the shaft 75. And this counterweight also serves to hold U-shaped member 76 approximately in the position shown in broken lines Fig. 5, when the lifting device is not in use.

In the use of the lifting device for the anode basket, the shaft 75 is rotated by means of the crank 86 to move the U-shaped member 76 into a position slightly below that shown in full lines in Fig. 5, which will cause the rod or shaft 79 suspended therefrom to swing by its own

weight under hooks 81 provided on the straps 35, or if desired, this shaft may readily be moved by hand, when in its lowered position, under hooks 81. The crank 86 is then turned to move the U-shaped member upwardly and thereby lift the anode basket from the full line position shown in Fig. 5 into the broken line position, in which the anode basket is located above and mainly at one side of the tank.

The lifting of the work basket 14 may be effected by any suitable overhead lifting device such as a crane which may be connected with the eye 22 on the beam 21. When this beam is lifted upwardly, it will carry with it the two straps 20 together with the work basket, the gears 47, 49 and 50 and the segment 54, the teeth thereof moving out of engagement with the teeth of the segment 55. The work basket may then be transported by means of the crane or lifting device into a position to discharge the plated material from the basket and into another position in which additional articles to be plated are placed into the basket. It is then moved back over the tank and lowered in a position in which the segment 54 meshes with the segment 55, whereupon the anode basket is again hung on the swinging rod 37 by turning the crank 86 in the reverse direction as the U-shaped member 76 swings from the broken line position shown in Fig. 5 to the full line position, the hook-shaped parts 36 will swing over the rod 37. The shaft or rod 79 is then disengaged from the hooks 81, whereupon the crank 86 is again turned to move the U-shaped lifting member into the broken line position in Fig. 5, whereupon plating may be resumed.

It is also a feature of this apparatus that when the work basket is lowered into its operative position within the tank, certain electrical terminals or contacts are brought together through which a circuit may be completed for conducting current to the apparatus for effecting the plating. In the construction shown for this purpose, the upper portions of the supporting straps 20, which are made of insulating material, have current conducting and supporting blades or members 90 rigidly secured thereto. On the upper edges of the tank are mounted a number of pairs of current conducting members or terminals 91 and 92, one for each blade or member 90, and the upper ends of the members 91 and 92 flare outwardly. The parts of the members 91 and 92 below the outwardly flaring parts are spaced apart just sufficient to receive between them the terminals or blades 90, so that these parts cooperate in the same manner as knife switches. In order that a good contact may be established between the blade 90 and the switch members 91 and 92, the member 91 is preferably loosely or flexibly hinged on the upper edge of the tank, for example, by attaching the middle portion thereof on one end of a woven or braided copper cable, the other end of the cable being secured to a suitable insulating plate which is in turn secured to the tank. The member 91 is then pressed toward the member 92 by means of a spring 93 of any suitable construction made to urge the flat inner face of the member 91 into good electrical contact with a face of the blade 90. 93*a* is a back-up member which prevents excessive distortion of the spring. By means of this construction, the member 91 will adjust itself to any misalinement of the blade 90. When the work basket is in lowered or operative position in the tank 11, the terminals or blades 90 connected therewith are in current conducting relation to the members 91 and 92. The blades or terminals 90 preferably have integral parts 94 which may be bolted or otherwise secured to the upper portions of the straps 20 and which may be provided with suitable connectors 95 to which conductors leading to the plating apparatus are connected. The current carrying members 91 and 92 may be mounted on insulating plates or members 96 suitably mounted in fixed relation to the tank 11. These current conducting terminals 91 and 92 also serve the further purpose of guiding the article carrier into such correct operative relation to the tank that the segment 54 will mesh with the segment 55.

In the operation of the machine when it is desired to stop the machine, the operator actuates the clutch 63 in such a manner that the work basket will stop approximately in its normal or central position as shown in Fig. 5. After the work basket has been removed from the tank, it may be swung about the trunnions 24 to dump the work and is then again returned to its normal or central position. In case the clutch is not so actuated as to stop the work basket in its normal or central position, then the weight 57 of the segment 55 will move this segment and the parts mounted on the tank and connected therewith into a central or intermediate position. Consequently, if the work basket 14 is swung manually into its central position and the weight 57 has moved the parts of the mechanism mounted on the tank into a corresponding position, then when the work basket is lowered into the tank, the parts will be in correct relation to each other to operate correctly so that the work basket will not be swung excessively toward either side of its intermediate position.

All of the terminals or blades 90 of the removable part of the apparatus and the terminals 91 and 92 may be connected to the anode and cathode in any desired manner. The conductor 42, for example in Fig. 5, which leads to the swinging rod 37 and the anode basket 32 may be connected to one of the connectors 95, and a pair of conductors 28 leading to the cathode terminals 29 may be connected to the other terminal 95 on the same end of the apparatus. However, if desired, both terminals on one end of the apparatus may be connected to the cathode terminals 29 while the other two terminals on the other end of the machine may be connected with the anode basket. Current may be conducted to the terminals 91 and 92 from an outside source in any usual or suitable manner (not shown).

In Figs. 7 to 9 inclusive, I have shown a modified construction in which a different type of drive is used for oscillating the work-receiving basket 100. In this construction, this basket is also suspended from straps or supporting members 101 having trunnions 102 extending into bores in the enlarged hubs or bosses 103 of the opposite ends of the work supporting basket 100. In place of a gear drive for oscillating the basket 100, I provide a belt 104 of the type provided with knobs or inwardly extending projections 105 formed to engage in depressions 106 which are formed on the peripheral portion of the enlargement or boss 103 of the work supporting basket. The belt 104 which is made of rubber or other insulating material also meshes with sprocket 108 mounted on a shaft 109 made of conducting material and provided at its inner end with a crank 110 which connects with an anode rod 111. The other end of the swinging shaft is provided with a crank 112 mounted on the shaft 114. This crank 112 is made of insulating material but is otherwise similar to the crank 110. 115 represents a brush or other contact device which engages the shaft 109 for carrying current to the swinging rod 111 and from this shaft through the suspending straps 117 to the anode basket 118. A similar brush or contact device 116 engages the shaft 114 which is connected with the cathodes of the work basket as will be described. The upper ends of the main supporting straps 101 for the work basket 100 are not shown in Fig. 7, since they may be similar in construction to that shown in the preceding figures so that the side arms 101 and the work basket 100 may be lifted upwardly out of the tank.

The shaft 109 also has secured thereto a gear 120 which meshes with a pinion 121 mounted on a drive shaft 122 on which a segment (not shown) similar to the segment 54 is mounted for cooperation with the drive

which may be identical with that described in connection with Figs. 1 to 6.

It is, of course, also possible in either of the constructions shown to employ cathode terminals within the work supporting basket which are secured to the basket itself and which replace the dangling terminals **29** shown in the preceding figures. Such terminals **125** may, for example, be in the form of plates or strips secured to the inner surface of the work supporting basket. When this type of terminal is employed, the cathode strips may be connected to a conductor **126** arranged on the exterior surface of the work basket **100** through bolts or the like extending through suitable openings in the basket. At an end of the work supporting basket, these conductors pass around gripping or holding devices **127** which secure the conductors to an end of the basket and these conductors then extend partly around the hubs or bosses of the basket which extend about the trunnion **102** and then upwardly and partly around a pulley or wheel **128**. The ends of the conductors are secured to the wheel **128**, which, being made of metal and secured to the metal shaft **114**, constitutes a part of a circuit to the brush **116**.

The apparatus shown has the advantage that it requires a relatively small amount of power to swing the work basket, since the pivotal axis about which it swings is relatively low. The basket is so constructed with relation to the swinging shaft **41** that the anode is substantially equidistant from the work during all positions of the basket. The bottom wall **15** is nearer to the axis of the basket than the walls or panels **16** to provide better shifting of the workpieces relatively to each other during oscillation of the basket, and consequently, when the basket is in a position in which the work is on the bottom wall, the anode basket will be at a higher elevation than when the work basket is in the position shown in Fig. 6. Similarly as the work moves to opposite sides of the work basket, the anode basket also swings toward those sides and downwardly toward the work. Consequently, the rate of deposit of metal on the work will be substantially constant during all positions of the basket, thus reducing the time required to plate a quantity of articles.

It will be noted that the lifting mechanism for the anode is so arranged as to move the anode to one side of the tank out of the path of movement of the carrier out of the tank.

By means of the construction described, the anode basket may be kept at all times closer to the work than in prior apparatus, thus reducing the voltage required to effect the plating.

It will be understood that various changes in the details, materials, and arrangements of parts which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention, as expressed in the appended claims.

I claim as my invention:

1. In an electroplating apparatus, including a tank for containing an electrolyte, a work basket in said tank for the articles to be plated and pivoted to swing relatively to said tank, about an axis extending lengthwise of said basket approximately midway between the sides thereof, said basket having a bottom formed of two perforate panels extending lengthwise of the same and arranged at a re-entrant angle to each other, the sides of said basket being spaced at a greater distance from said axis than the distance between said axis and said bottom, mechanism for oscillating said work basket about its axis through an arc located mainly below said axis, and an anode arranged above said basket and mounted to swing about a substantially horizontal axis extending substantially parallel to the axis of said work basket, mechanism mounted on said tank for swinging said anode in an arc about another substantially horizontal axis arranged mainly above said axis of said anode.

2. In an electroplating apparatus including a tank for containing an electrolyte, a work basket in said tank for the articles to be plated and which has a raised portion extending lengthwise of the bottom thereof, mechanism for alternately swinging said basket from side to side about an axis extending lengthwise through said basket parallel to said bottom and in closer proximity to said bottom than to the sides of said basket to cause the articles to shift from one side to the other of said basket and to cascade over said raised part, an anode arranged above the bottom of said basket and movable relatively to said basket from side to side to follow the articles in their movement, and means for moving said anode in an upwardly bowed path during said side to side movement to maintain said anode in approximately the same spaced relation to said articles during said movement.

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