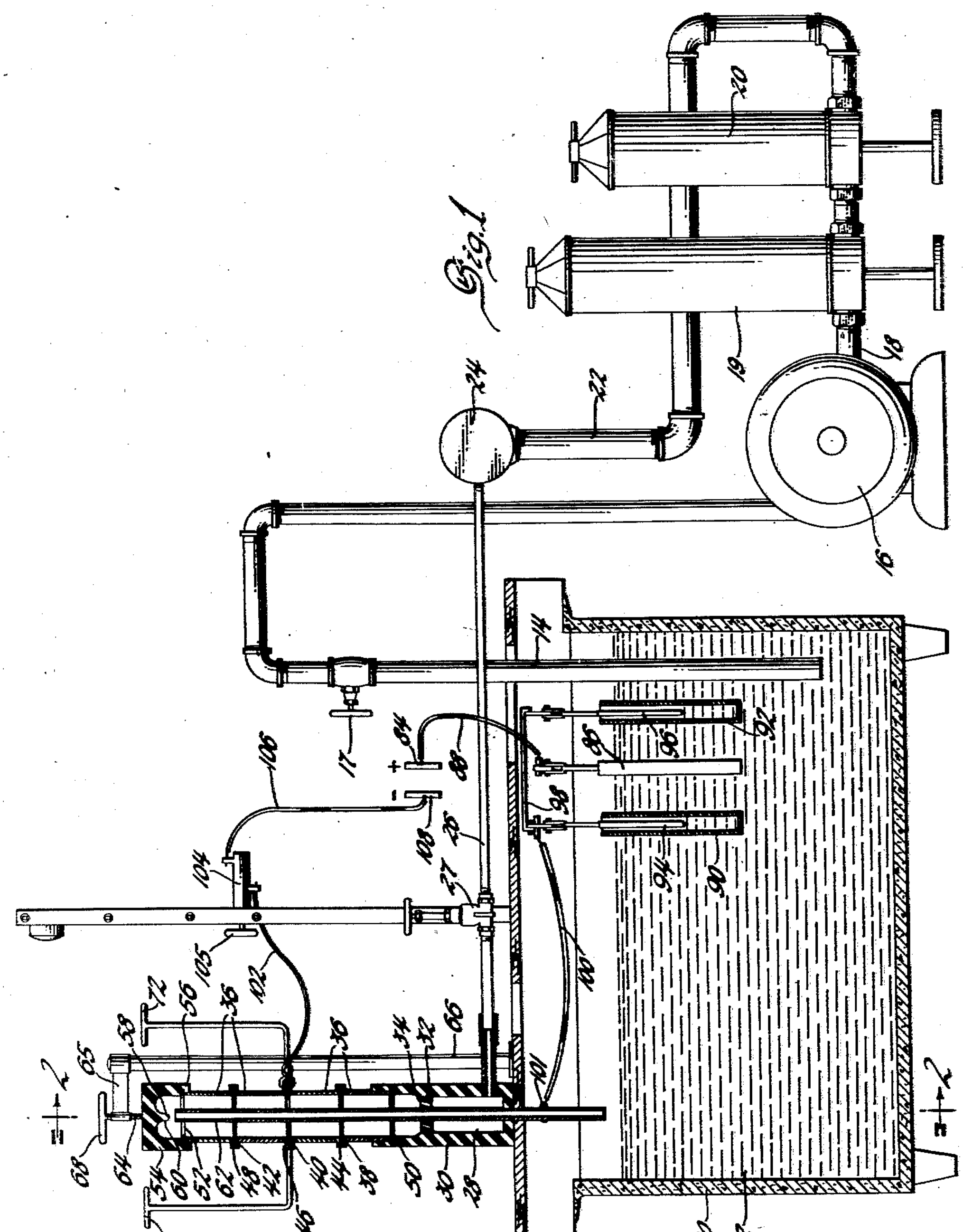
Dec. 2, 1947. W. M. MARTZ 2,431,949

APPARATUS FOR ELECTROPLATING THE INSIDE OF BEARING SHELLS AND THE LIKE

Filed Nov. 24, 1943 3 Sheets-Sheet 1

Fig. 1



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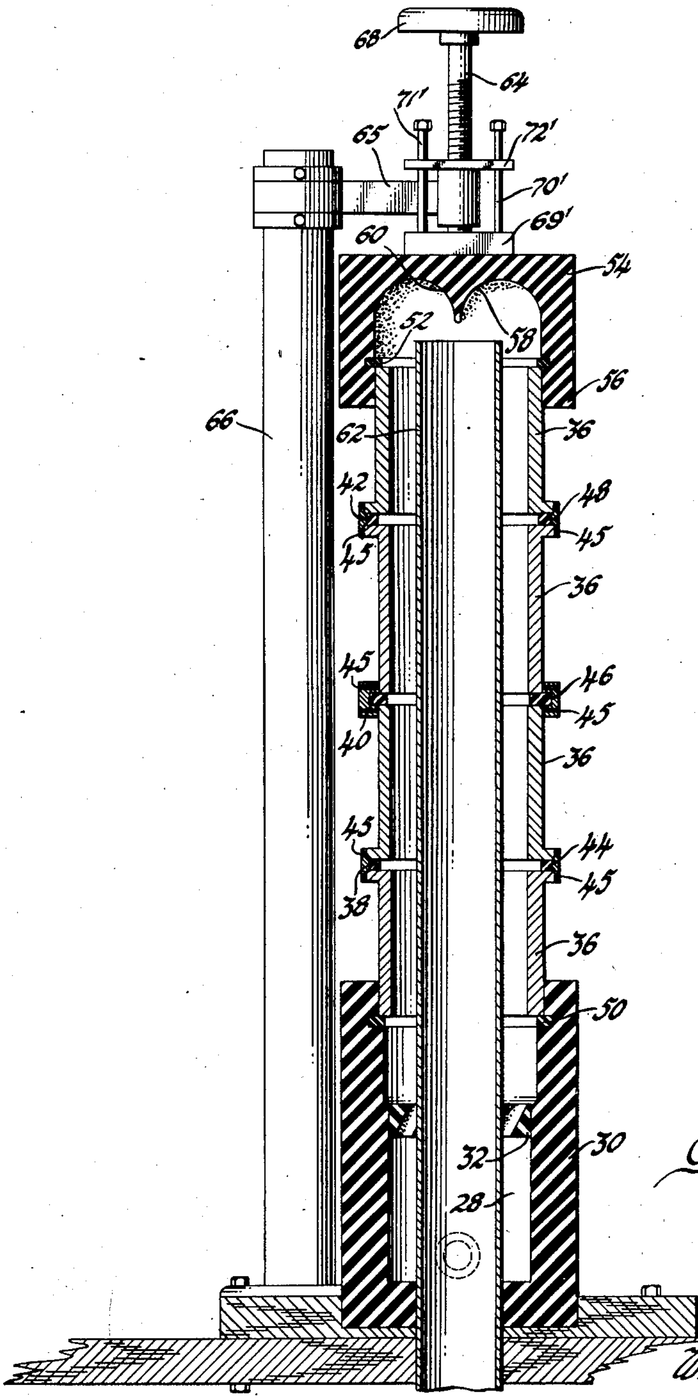

Fig. 2

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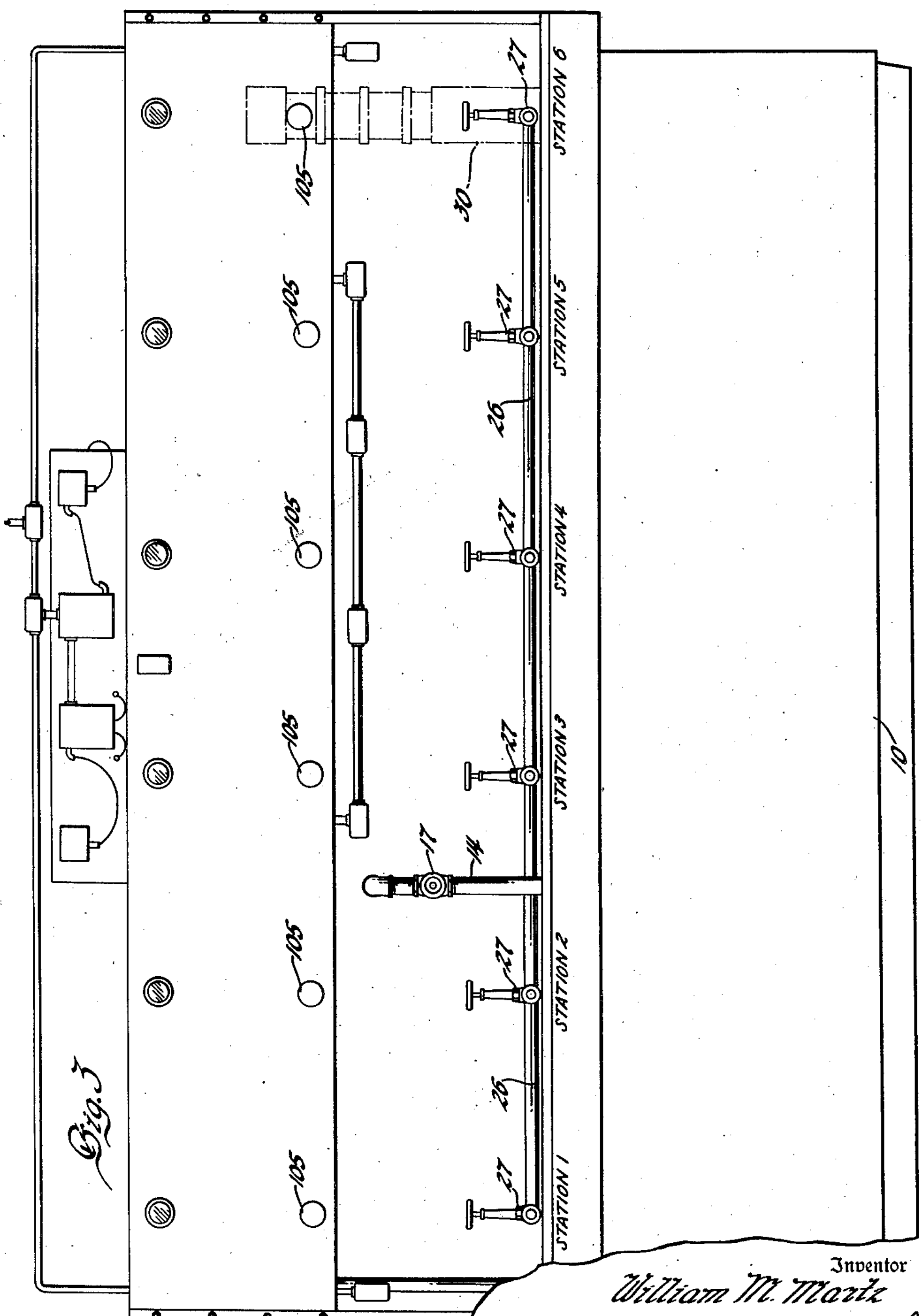

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APPARATUS FOR ELECTROPLATING THE INSIDE OF BEARING SHELLS AND THE LIKE

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This invention relates generally to the art of electrodepositing metals and more particularly to electrodepositing a layer or coating of metal on the inside of bearing shells and the like.

High quality bearings such as employed in aircraft engines may be made by electrodepositing a layer or layers of relatively soft metal or alloy having good antifrictional properties onto a support of a harder and stronger metal which acts as the cathode during the plating operation. Different forms of apparatuses have been proposed heretofore for electrodepositing metal on the inside of bearing shells and the like. While some of the plating apparatuses or devices have given satisfactory results and many high quality bearings produced thereby, all those apparatuses of which I am aware are subject to one or more disadvantages.

In plating bearings and the like it is desirable to electrodeposit the relatively soft metal at a rapid rate requiring relatively high current densities. This factor, along with others, makes it necessary or advantageous to provide a considerable amount of agitation of the plating solution. In some apparatuses heretofore employed reliance is placed on more or less complicated devices to agitate or rotate the anode and/or cathode during the process of electrodeposition in order to provide effective agitation and to bring a supply of fresh plating solution to the inside surface of the bearing shells. In other constructions a rotary means such as an impeller may be employed to provide agitation of the plating solution and which rotary means may be employed either by itself or with means to agitate or rotate the anode and/or cathode. Such movable means are not required in the preferred embodiment of my invention and the plating solution is agitated and a supply of fresh plating solution is brought continuously into contact with the inside surface of the bearing shells by simple means.

Another disadvantage of some apparatuses heretofore employed is that masking of the bearing back or shell forming the cathode is necessary. The procedure of applying the masks and removing the same after plating is not only time consuming but the masks are a cause of plating rejections due to plating solution being trapped in the various types of masks employed. In the preferred embodiment of my invention no external masking devices are necessary. Some devices, also, are able to plate a single bearing shell at a time in each unit.

One object of the invention is the provision of an improved apparatus for plating bearing shells

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and the like that eliminates defects in devices heretofore employed.

Another object of the invention is the provision of an apparatus for plating bearings and the like that is characterized by its simplicity and ease of control.

A further object of the invention is the provision of an improved device of the class described in which it is practical to filter the plating solution so that only filtered solution flows past the cathode.

It is a further object of the invention to provide an improved apparatus for plating the inside of bearing shells and the like that eliminates the necessity of employing masking devices for the outside of the bearing shells.

A further object of the invention is to provide an improved means for maintaining a fresh and undepleted supply of plating solution at the surfaces to be plated.

It is also an object of the invention to provide an improved device of the class described in which no rotary devices are required in the electrolyte.

Another object of the invention is to provide a device of the class described in which only a small amount of floor space is required per stack of bearings or other articles being plated.

A further object of the invention is the provision of a simplified apparatus for plating bearing shells at a rapid rate and whereby a plurality of bearings can be plated at one time at each of a plurality of stations.

Another object of this invention is the provision in a device of the class described of means for maintaining the plating solution at substantially a constant composition.

Other objects and advantages of the invention will become more apparent from the detailed description which follows.

Reference is herewith made to the accompanying drawings illustrating an apparatus in accordance with one embodiment of the invention.

In the drawings:

Figure 1 is an elevational view partly in section illustrating an apparatus in accordance with the invention and showing specifically the construction at one of a plurality of stations.

Figure 2 is an enlarged sectional view of a slightly modified form of a portion of a device illustrated in Figure 1, the view being taken on a line corresponding to 2—2 in Figure 1.

Figure 3 is an elevational view of the device of Figure 1 showing a plurality of plating stations.

In the drawings, 10 indicates a suitable tank having therein a supply 12 of the plating solution or electrolyte. A pipe 14 has one end extending into the electrolyte and its other end leads to a suitable pump 16. An adjustable valve 17 is provided in pipe 14 for adjustably controlling the flow of the electrolyte. The discharge side 18 of the pump leads to filters 19 and 20 for filtering the electrolyte. After leaving the second filter the electrolyte passes through pipe 22 to pressure cylinder 24. From the pressure cylinder 24 the electrolyte passes through a pipe 26 having a valve 27 therein into a chamber 28 in a hollow support 30 formed of a suitable non-conductor of electricity, such as hard rubber. Mounted in the hollow support 30 intermediate its ends is a hard rubber plug 32 having angularly disposed jet openings 34 adapted to impart a spiralling effect to the electrolyte as it flows therethrough. Arranged above the support 30 are a plurality of bearing shells 36, in this case four in number. Soft rubber gaskets 38, 40 and 42 are positioned between the adjacent bearing shells. Surrounding the adjacent ends of the bearing shells and the rubber gaskets 38, 40 and 42 are metallic clamping rings 44, 46 and 48. The metal clamping rings are secured to the bearing shells by screws 45 shown in Figure 2. When the screws are loosened the clamping rings may be removed and the bearing shells separated from one another. The four bearing shells together with the gaskets 38, 40 and 42 and the corresponding clamping rings form a generally tubular assembly or stack through which the electrolyte can flow, the gaskets preventing the plating solution from escaping. A soft rubber gasket 50 forms a liquid tight seal between the lower end of the lowermost bearing shell and the hard rubber support 30. Above the uppermost end of the uppermost bearing shell is another soft rubber gasket 52 which forms a tight seal between the upper bearing shell and a hard rubber cap or closure member 54. The closure 54 has a downwardly extending wall 56 which surrounds the upper end of the uppermost bearing shell and has curved portions 58, 60 for directing the electrolyte downwardly and into a hollow anode 62 within the several bearing shells and coaxially therewith. The plating solution then passes downwardly through the tubular anode and is discharged into the tank 10. Figure 1 illustrates one type of clamp or holding means for the cap. In this figure the closure or cap 54 is held in position by screw-clamping means 64 mounted in an arm 65 rotatably carried by a stationary column 66. The screw-clamping means 64 is tightened or loosened by the hand wheel 68. When the means 64 is in loosened position the arm 65 and parts carried thereby can be swung to one side to permit easy removal of a plated set of bearing shells and easy insertion of an unplated set. Handle members 70 and 72 are fixed to ring 46. By means of the handles the entire stack of bearings can be removed as a unit, whereupon a new stack of unplated bearing shells can be placed in position for plating.

A modified form of construction for holding a cap 54 in place is shown in Figure 2. This construction additionally includes member 69' interposed between the end of screw 64 and the cap 54. Fixed to member 69' are two headed-rod members 70', 71' which pass loosely through a support 72'. The purpose of member 69' is to apply pressure to the cap 54 over a wider area than may be had by the screw 64 alone.

In all cases it is not required that a clamping means be used to hold the cap in position. The downwardly extending wall 56 of the cap 54 may form a sufficiently tight fit with the upper bearing shell as to be held in frictional engagement with the bearing shell during the plating operation. This lever device may be a cam action or other similar type. In some cases, if the solution flow is controlled, there is no need for the cap device 54, consequently no need for the locking device. All that is necessary in this case is to have the top of the anode tube 62 slightly below the top of the uppermost bearing and then adjust the flow so that the anode tube can accommodate the flow of electrolyte which is forced through the bearing stack and then drains by gravity through the anode tube. This means that the usual flow of electrolyte which has passed through the bearing stack at any given time (when using a cap device) must be decreased.

In the constructions shown herein the hollow anode 62 is of insoluble material. Where the metal being plated is silver, for example, the insoluble anode 62 may be of iron or platinum. Where an insoluble anode is used it is necessary to replenish the metal that is electro-deposited out of the electrolyte. In the apparatus illustrated this is accomplished by connecting the positive bus bar 84 to a silver anode 86 in the electrolyte in the reservoir or tank 10, connector 88 being provided for this purpose. Extending into the electrolyte in the tank and arranged near the anode 86 are porous cups 90 and 92 having sheet steel cathodes 94 and 96 respectively arranged therein. The two cathodes 94 and 96 are connected to each other by current conductor 98. A current conductor 100 connects the two cathodes 94 and 96 to the hollow anode 62 at point 101. Current conductor 102, rheostat 104 having means 105 for varying the resistance therein, and conductor 106 connect the stacks of bearing shells as cathode to a negative bus bar 108. During the plating operation the current flow from positive bus bar 84 to negative bus bar 108 is through conductor 88 to anode 86, through the electrolyte in tank 10 to the cathodes 94 and 96, then through conductor 100 to the hollow anode 62, through the electrolyte flowing in the space between the hollow anode and stack of bearing shells as cathode, then through conductor 102, rheostat 104 and conductor 106 to the negative side of the line. By means of the described system, a silver is plated on the inside of the several bearing shells making up the stack by means of electric current passing through the electrolyte flowing between the hollow anode and stack of bearings an equivalent weight of silver is put back into solution through the porous cell arrangement. This maintains a substantially constant electrolyte composition.

The hollow anode 62 might be made of the material to be deposited and in such case the porous cell arrangement could be dispensed with. In this case the hollow anode 62 is directly connected to the positive bus bar. In this case the hollow anode 62 must be renewed from time to time as it passes into solution upon electrolysis.

Where an insoluble anode 62 is employed the metal that is plated out could be replenished from time to time by adding a salt of the metal to be electrodeposited to the solution in the tank or reservoir. This does not maintain a substantially constant bath composition as does the porous cell arrangement illustrated in Figure 1 of the drawings.

Figure 3 illustrates the manner in which more than one stack of bearing shells may be plated at one time. In this instance there are six stations. At station 6 is shown in dotted outline one stack or assembly of bearing shells, cover and support similar to that shown in Figure 1. A similar assembly may be mounted at each of stations 1 to 5 inclusive. The flow of electrolyte to each station may be cut off entirely or controlled in amount by the individual valves 27 in the similar individual pipes 26 leading to the several stations from the pressure cylinder 24. The capacity of the pressure cylinder 24 is preferably made relatively large whereby the shutting off of one or more of the valves 27 will have comparatively little effect on the flow characteristics through the remaining plating units.

At each station there may be a porous cell system similar to that at the station shown in Figure 1 in order to maintain the electrolyte composition or concentration substantially constant.

In the operation of the apparatus an assembled stack of unplated bearing shells including the rubber gaskets and clamping rings will be mounted in a hollow support 30 and in spaced relation to a hollow anode. A rubber cap 54 will then be placed over the upper end of the stack of bearing shells and held thereon as by clamping or holddown means 64. A suitable conductor 102 may be then attached to the stack of bearing shells which form the cathode. The pump 16 is operated to pump electrolyte from the tank 10 to the pressure tank 24 and during its flow it is passed through the filtering devices 19 and 20. The valve 17 may be adjusted to control the flow of electrolyte. From the pressure tank the electrolyte flows through the pipes 26 each having an adjustable valve 27 to control or shut off the electrolyte, into the hollow supports 30, then upwardly through the jet or orifice plates 32 into the spaces between the anodes and stacks of bearing shells and finally by means of the curved surfaces on the caps 54 into the hollow anodes where the electrolyte is returned to the tank 10. The orifice or jet plates 32 impart effective agitation to the electrolyte as it passes between the hollow anodes and stacks of bearing shells. High current densities may be employed because of the effective agitation. The electrolyte is kept out of contact with the outer sides of the several bearing shells and no masking is required. By means of the filters as described only clean filtered solution or electrolyte comes in contact with the bearing shells being plated. In the construction employing the porous cell arrangement in the electrolyte in tank 12, the concentration or composition of the electrolyte may be maintained substantially constant at all times.

When a desired thickness of metal has been deposited it is a relatively simple matter to remove a plated stack of bearing shells and to insert an unplated stack. The entire construction is characterized by its simplicity and ease of control and adjustment.

Various changes and modifications of the embodiments of my invention described herein may be made without departing from the spirit and principles of my invention.

I claim:

1. An apparatus for electrodepositing metal on the inside of bearing shells and the like, a first tank containing a supply of electrolyte, a pressure tank, a pump for pumping electrolyte from the first tank to the pressure tank, a plurality of pipes leading from the pressure tank, a plurality of hollow supports above the first tank, each of which is adapted to support a stack of bearing shells forming a tubular cathode and each of which receives electrolyte through one of the pipes, a tubular anode of insoluble material within each of the stacks of bearing shells, spaced therefrom and extending downwardly through a hollow support, a cap member for the upper end of each of the stacks of bearing shells and being spaced from one end of the tubular anode within the corresponding stack of bearing shells, the arrangement of each hollow anode, stack of bearing shells, and cap thus being such that electrolyte is caused to flow upwardly in the space formed by an anode and stack of bearing shells until it reaches the top of said stack and then is directed by the cap downwardly into and through the hollow anode for return to the first tank, a plurality of anodes of the metal to be electrodeposited on the bearing shells disposed in the electrolyte in the first tank, a porous cup adjacent each last mentioned anode, a cathode within each porous cup, and electrical connections from the positive side of a source of direct current to each of the last mentioned anodes, from each of the last mentioned cathodes to each of the hollow anodes, and from each of the stacks of bearing shells to the negative side of the source of direct current whereby as metal is electrodeposited onto the inside of the stacks of bearing shells a corresponding amount of metal goes into solution in the electrolyte in said first tank.

2. An apparatus as in claim 1 in which an annular plate having angularly arranged jet openings is mounted in each hollow support between an anode and the walls of said hollow support at a point below a stack of bearing shells whereby a spiralling effect is imparted to the electrolyte as it flows through said openings and upwardly in the space formed by an anode and stack of bearing shells.

3. An apparatus for electrodepositing metal on the inside of bearing shells and the like comprising, a first tank containing a supply of electrolyte, a pressure tank, a pump for pumping electrolyte from the first tank to the pressure tank, a plurality of generally cup-shaped supports above said first tank, each cup-shaped support having a base and upwardly extending walls of generally circular shape, the upper portions of said walls adapted to engage in liquid tight-relation and support a stack of bearing shells connected together to form a tubular cathode, each one of said bases having an opening centrally arranged therein, a plurality of tubular anodes of material insoluble in the electrolyte, each anode having an upper portion within a tubular cathode, an intermediate portion within a cup-shaped support and a lower portion extending through one of said openings, each one of said upper portions being spaced from one of said tubular cathodes to form an annular passageway for electrolyte between a tubular cathode and a said upper portion, each one of said intermediate portions being spaced from said walls and forming therewith a passage of annular shape, each one of said lower portions being in liquid-tight engagement with one of said openings, a plurality of annular plugs, each of said plugs being supported in a said annular passage between said intermediate portion and said walls at a point between said base and upper end of said walls, each of said plugs having angularly arranged jet openings to impart a spiralling effect to electrolyte as it flows there-

through, a plurality of caps, each of said caps being in liquid-tight engagement with the upper end of one of said tubular cathodes and spaced from the upper end of one of said tubular anodes, a plurality of pipes leading from the pressure tank, each of said pipes being connected to one of the cup-shaped supports below the annular plug therein, whereby electrolyte under pressure is caused to flow through the angularly arranged openings, then spirally upward through a said annular passage to the upper end of a tubular cathode and then downwardly through each tubular anode to said tank, valve means in each of said pipes, a plurality of anodes of the metal to be deposited on the bearing shells disposed in the electrolyte in said first tank, a porous cup adjacent each last mentioned anode, a cathode within each porous cup, and electrical connections from the positive side of a source of direct current to each of the last mentioned anodes, from each of the last mentioned cathodes to each of said tubular anodes, and from each of the stacks of bearing shells to the negative side of the source of direct current whereby as metal is electrodeposited onto the inside of the stacks of bearing shells a corresponding amount of metal goes into solution in the first tank.

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