March 27, 1956 C. W. FORESTEK 2,739,937

ALIGNED ANODE APPARATUS

Filed Sept. 5, 1952 4 Sheets-Sheet 1

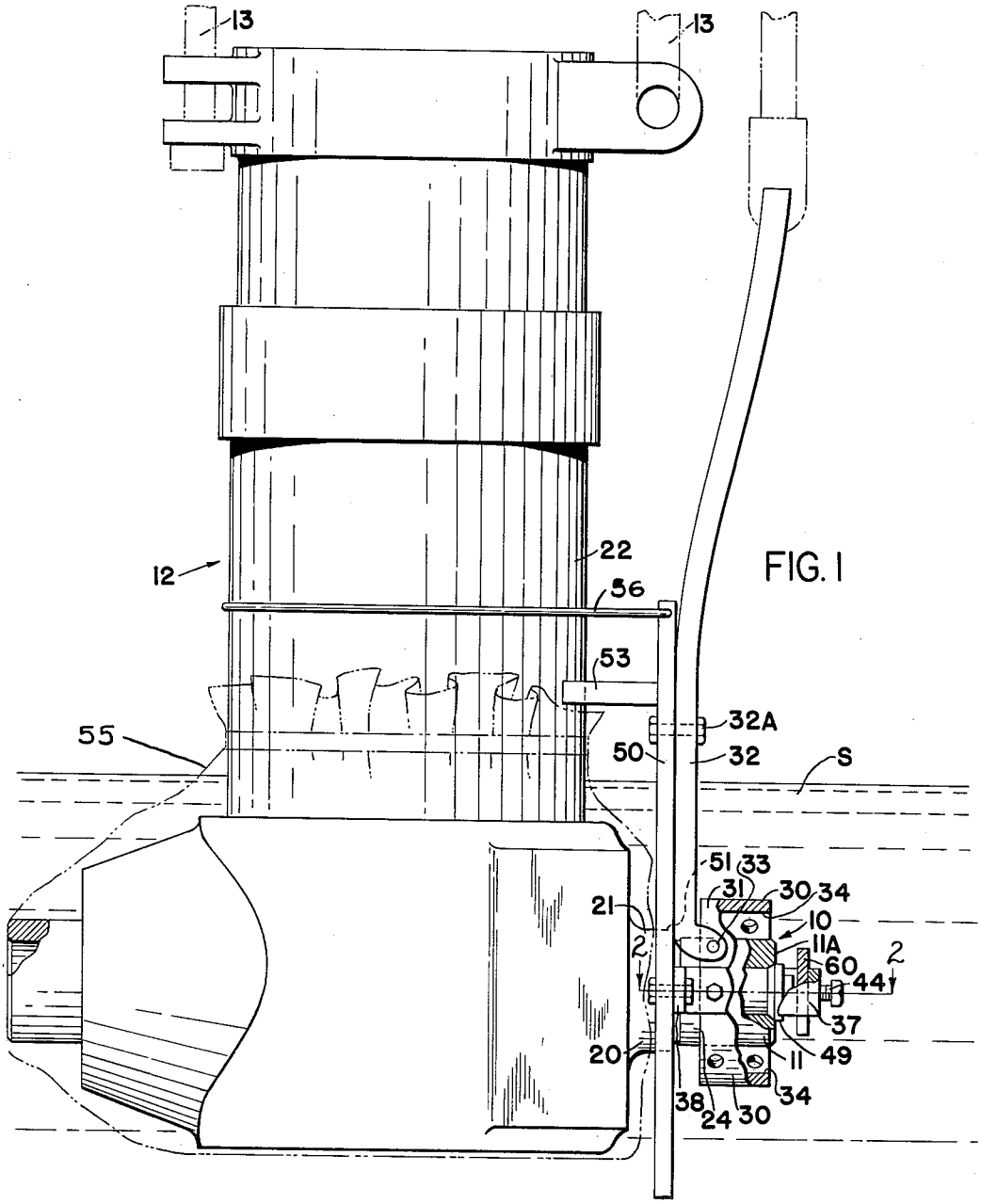


FIG. 1

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ALIGNED ANODE APPARATUS

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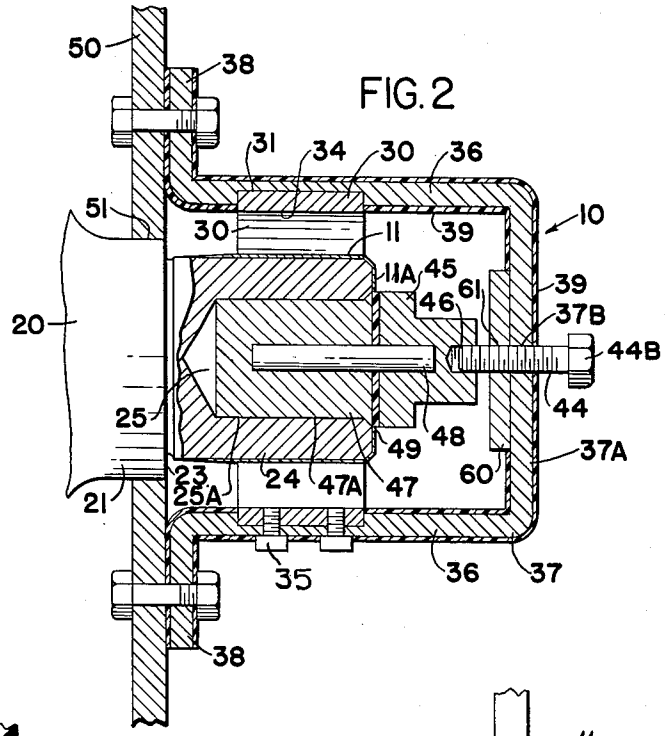


FIG. 2

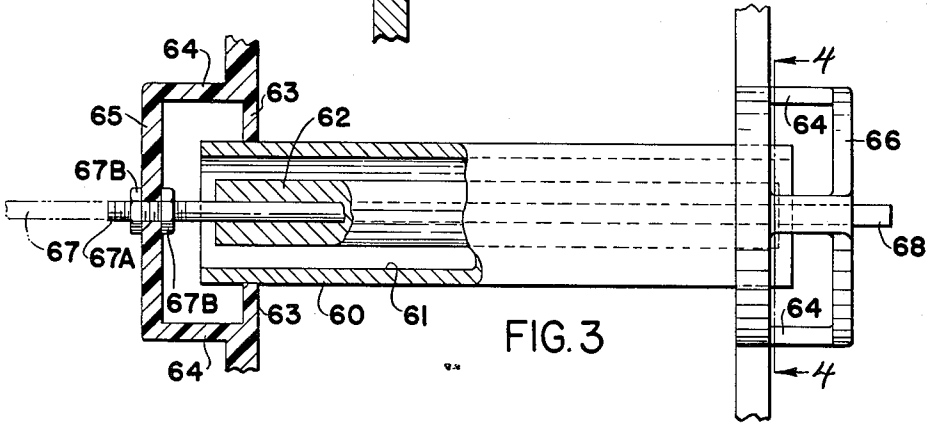


FIG. 3

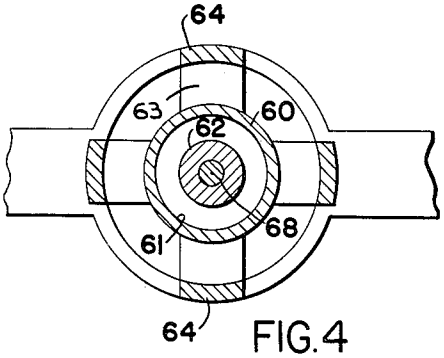


FIG. 4

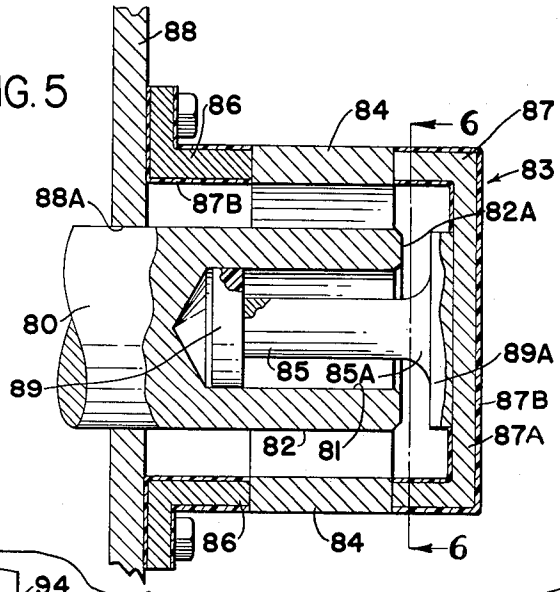
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ALIGNED ANODE APPARATUS

Filed Sept. 5, 1952 4 Sheets-Sheet 3

FIG. 5



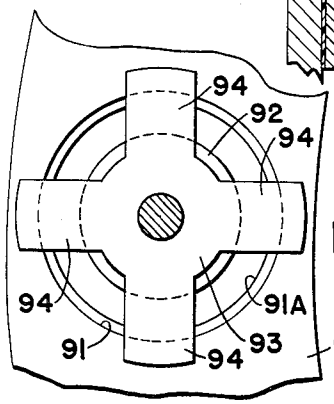


FIG. 8

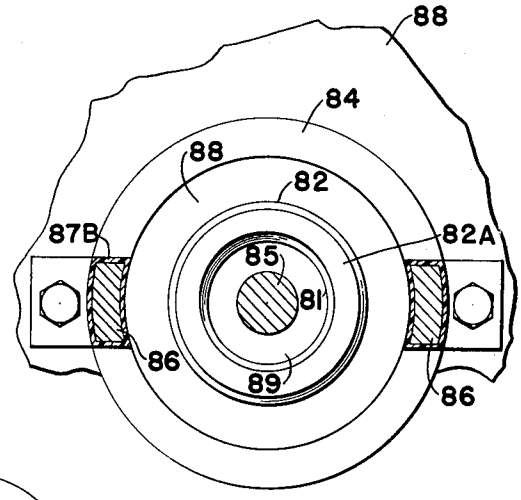


FIG. 6

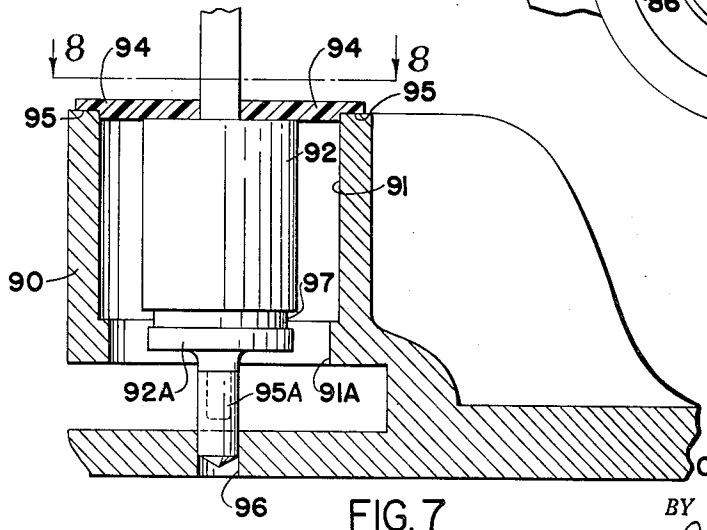


FIG. 7

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ALIGNED ANODE APPARATUS

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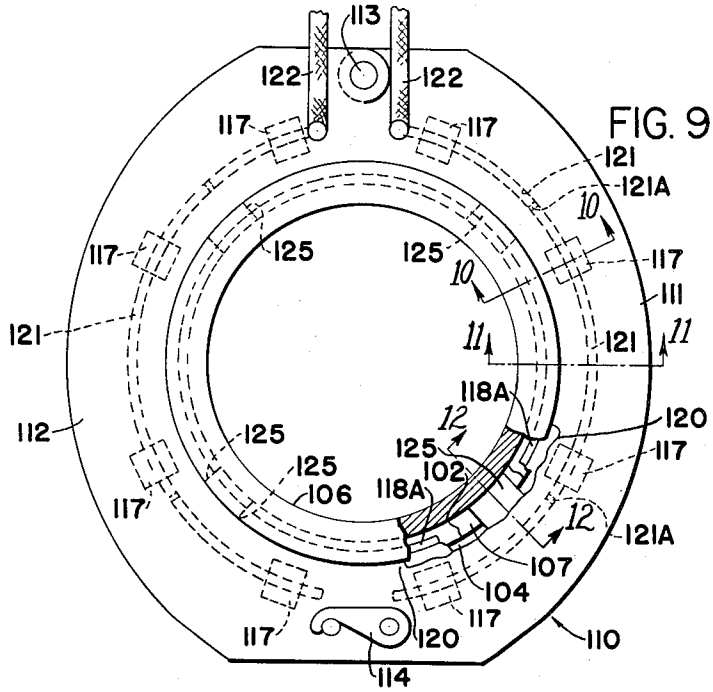


FIG. 9

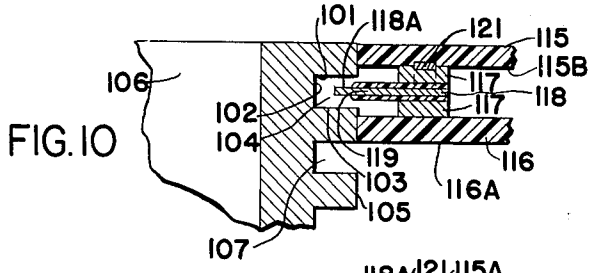


FIG. 10

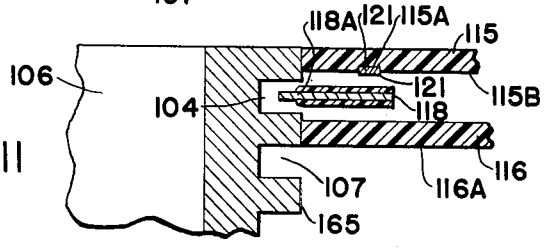


FIG. 11

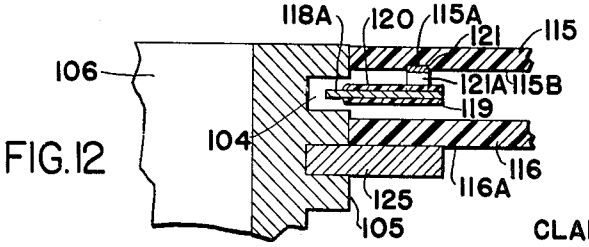


FIG. 12

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United States Patent Office 2,739,937 Patented Mar. 27, 1956

2,739,937

ALIGNED ANODE APPARATUS

Clarence W. Forestek, Cleveland, Ohio

Application September 5, 1952, Serial No. 308,049

4 Claims. (Cl. 204—286)

This invention relates to the electrodeposition of metals and in particular relates to new and novel mechanical apparatus designed to more effectively accomplish such electrodeposition.

In the art of electroplating, it is a fundamental thesis that the rate of plating a deposit of specified thickness on a cathodic surface is directly affected by the distance that the anode is located from the cathodic surface being plated. For example, in the field of hard-chrome plating, an optimum spacing of one-half inch between the anode and cathode has been found to produce excellent results. However, in installations where a spacing of one-half inch is not feasible, it is manifest that satisfactory results can be obtained by using a different spacing and varying the voltage to control the current density and thus compensate for the change in spacing in known manner.

In the past, attainment of the aforementioned desired spacing arrangement has been accomplished by manual positioning of the anode with respect to the cathodic surface. In addition to requiring the services of a highly skilled operator to effectuate this positioning, the present method is undesirable in that it results in an obvious lack of uniformity between similar parts that are plated during a production run.

However, the most serious disadvantage resulting from employment of manual positioning method, stems from the impossibility to consistently locate the face of the anode exactly parallel with the face of the cathodic surface and yet maintain the requisite spacing therebetween. As a result of this failing, whereby the distance between the face of the anode and the face of the cathodic surface varies, it follows that an uneven plated deposit will result on the face of the cathodic surface. This is true because the thickness of the electrodeposit of metal on a cathodic surface is directly affected by the distance that the same is spaced from the anode. The detrimental aspects of such a condition are twofold.

First, it is manifest that because of the uneven thickness of the plated cathodic surface, a minimum thickness, equivalent to the minimum thickness specified, must be provided, notwithstanding the fact that the aforementioned misalignment creates several plated areas on the cathodic surface where the thickness of plated deposit is far greater than required by specification. This excess of plated deposit just described is at best a waste of material, and in addition constitutes the second disadvantage which arises by virtue of the labor cost involved to remove the excess deposit so as to present a cathodic surface having a plated deposit thereon of uniform thickness.

Accordingly, it is one object of this invention to provide an anode apparatus having means thereon for automatically locating the same in spaced parallel relationship with a cathodic surface to be plated.

It is a further object of this invention to provide an anode apparatus capable of quick but accurate positioning with respect to a cathodic surface to be plated.

It is a further object of this invention to provide an anode apparatus capable of alignment with a cathodic surface to produce a uniformly thick electrodeposit of metal of predetermined thickness, on said cathodic surface.

It is a further object to this invention to provide an anode apparatus which upon usage to electrodeposit metal eliminates the need for the subsequent grinding operation normally employed to render the deposit uniform.

It is a further object of this invention to provide an automatically aligning anode apparatus for use in the electrodeposition of metals, whereby the need for skilled labor to manually position the anode is eliminated.

It is a further object of this invention to provide an apparatus for use in the electrodeposition of metals, whereby waste of materials and labor in the form of excess plated deposits, and labor cost to remove the same respectively, are eliminated.

It is a further object of this invention to provide an anode apparatus characterized by the ability to selectively electrodeposit one or more specified thickness of metal at selected areas during the same time interval.

It is a still further object of this invention to provide an aligned anode apparatus, having means thereon for restricting the area in which electrodeposition will take place.

These and other objects of the invention will become more apparent upon consideration of the following brief specification, read in the light of the accompanying drawings.

Of the drawings:

Figure 1 is a side elevation, partly broken away and in section, and illustrating one embodiment of the invention as applied to a part to cause electrodeposition of a portion of the same.

Figure 2 is a sectional view, taken horizontally on the lines 2—2 of Figure 1.

Figure 3 is a side elevation, partly broken away and in section, and illustrating a modified form of the invention.

Figure 4 is vertical section, taken on the lines 4—4 of Figure 3.

Figures 5 and 6 are views illustrating a modified form of the invention.

Figures 7 and 8 are views illustrating a further modified form of the invention.

Figure 9 is a top plan view, illustrating how a modified form of the invention can be adapted to use in the plating of piston ring grooves.

Figures 10, 11, and 12 are sectional views taken on the lines 10—10, 11—11, and 12—12, respectively of Figure 9.

Referring now to the drawing, and in particular to Figures 1 and 2 thereof, the aligned anode apparatus, generally indicated as 10, is shown positioned so as to electroplate a bearing surface 11 of a part 12, the latter being shown suspended by lugs 13, 13 in an electrolytic plating solution S.

While the following paragraphs will disclose that aligned anode apparatus 10 can be adapted to plate selected areas on parts of varying size and shape, the form of the invention shown in Figures 1 and 2 is designed for use in plating the exterior bearing surface 11 of a trunnion 20 provided on the part 12. As best shown in Figure 1, the trunnion 20 includes a cylindrical member 21, projecting outwardly from the main body 22 of the part 12 and having one end thereof defining a shoulder portion 23. A symmetrical cylindrical extension 24 of reduced cross-sectional diameter, projects outwardly from the shoulder 23 in aligned relationship with cylindrical member 21 and includes an exterior bearing surface 11

as well as a cylindrical recess 25, also aligned therewith and being defined by the wall surface 25a thereof.

With particular reference now to the construction of the aligned anode apparatus 10, the same is shown as including a cylindrically formed lead anode 30, having the exteriorly formed surface 31 thereof connected to a lead or other electrically conductive lead 32, as at 33, and also having the interiorly presented surface 34 thereof spaced equidistant from the surface 11 of the extension 24 by means to be described.

To this end, the exteriorly presented surface 31 of the anode 30 is shown secured, as at 35, to legs 36, 36 of a U-shaped frame member 37. Flanged extensions 38, 38, provided on the freely disposed ends of the legs 36, 36, facilitate attachment of the same to one face of a rectangularly shaped plate 50 in known manner, while the central or base portion 37A of the member 37 serves to connect legs 36, 36 so as to form a complete juncture between diametrically opposed portions of the anode 30. Insulating tape 39 is shown wrapped around appropriate portions of the member 37, whereby the same may be prevented from causing unwanted plating deposits by virtue of immersion in the electrolytic solution S.

For the purpose of permitting electrodeposition of a different thickness of metal on a selected area 11A of the member 24, for example, a second anode 60 is shown positioned against the central portion 37A. Because all portions of the part 12 will be immersed for a uniform period of time, it is manifest that in order to produce different thicknesses of plate on the surfaces 11, and 11A respectively, the anode 60 will have to be made adjustable so that it can be positioned at varying distances from the surface 11A. To this end the central portion 37A, the anode 60, and a plug member 45 are shown provided with threaded apertures 37B, 61 and 46 respectively, the arrangement being such that a threaded bolt 44 may be operatively positioned with respect to the threaded apertures 37B, 61, and 46, so as to laterally adjust the anode 60 with respect to the members 37A and 45 upon the application of turning force to the end 44B of the bolt 44. (See Figure 2.)

While the aforementioned arrangement of component members serves to provide the requisite degree of lateral adjustment to the auxiliary anode 60, in the manner just described, the same may be also utilized to position the new and novel aligning means for locating the surface 34 of the anode 30 in equidistant spaced relationship to the bearing surface 11. To this end, a cylindrical aligning member 47, secured in spaced relationship to the plug 45 by a dowel 48, is shown received in aligned relationship within the cylindrical recess 25, the arrangement being such that the aligning member 47, the bearing surface 11, and the anode 30 are all positioned symmetrically about a common axis of rotation. From experience, it has been ascertained that best results can be obtained in controlling the selected area to be plated on the surface 11A by providing an insulating disc 49 of plastic or suitably insulated conductive material between the member 47 and the plug 45 as best shown in Figure 2.

By like token, supplementary aligning action may be provided by equipping a plate 50 with an aperture 51 of appropriate diameter and location so as to permit the same to be received over the cylindrical member 21 in aligning relationship. In addition the plate 50 is shown in Figure 1 as being of considerably greater area than is necessary to effectuate the just-discussed alignment with the member 21. The advantages of this construction are threefold. First, it permits the plate 50 to function as a barrier for stopping stray electrolytic currents emitting from the anode 30 and which would otherwise tend to cause an unwanted electrodeposit on other portions of the part 12. Second, it provides an area where the lead may attach as at 32A. Lastly, it provides an area for affixing a spacer arm 53 to further insure accurate positioning of the anode apparatus 10 with respect to the part 12. (See Figure 1.)

In cases where it is not necessary to plate the area 11A as just described, it is manifest that the overall anode apparatus 10 may be simplified by merely replacing the member 37A and the component parts attached thereto with non-conductive plates (not shown), which would merely constitute an enlarged version of the disc 49, secured directly to the legs 36, 36 in known manner.

In use or operation of the improved aligned anode apparatus on a high production run of identical parts, the various components making up the apparatus 10 are first made to the proper size and shape for use with the article to be plated. This may be accomplished in varied ways, depending upon the degree of accuracy required. For example, the aperture 51 and the member 47 may be made to the exact diameter necessary for aligned reception with the members 21 and 25 respectively. The same may then be assembled with respect to the anode 30, and in this condition the anode 30 may be machined using the aligned components of the unit as a guide. In this manner, the anode is made so as to be exactly equidistant from all corresponding surfaces of the bearing surface 11.

It accordingly follows that with the unit 10 accurately machined in the preassembled condition just described, the same may be quickly and accurately positioned with respect to the bearing surface 11 by merely slipping the aperture 51 past the surface 11 and into engagement with the member 21. (See Figure 2.) Simultaneously with this engagement the surface 47A of the member 47, will be positioned against the wall surface 25A of the cylindrical recess 25, and as a result of these aligning actions, the anode 30 will be automatically aligned in exactly equidistant relationship to the bearing surface 11.

In this condition, the part 12, together with the unit 10 mounted thereon as described, may be immersed in the electrolytic solution S and the electric current may then be turned on. During the plating cycle it is manifest that the majority of all stray electrolytic deposits will be prevented from attachment to undesired surfaces of the part by virtue of the plate 50, which acts as barrier in this regard.

Insulation against any remaining electrolytic current is compensated for by the employing wrapping 55, while stability during electrodeposition is provided for by the use of wiring 56 between the part 12 and the plate 50.

With the plating cycle completed, the part 12 may be removed from the solution S, and the unit 10 may be removed therefrom by first removing the wiring 56 and then merely loosening the connection between the aligned parts and removing the same past the surface 11. The unit 10 is then ready for mounting on the next identical part in the same manner as just described.

From the foregoing it is manifest that there has been provided a new and novel "quick-attaching" unit for positioning a specially formed anode exactly equidistant from a correspondingly shaped surface to be plated. It has also been shown from the foregoing how the platable deposit is restricted to deposition on selected areas only, by virtue of the new and novel construction of the described apparatus.

In the description of the device 10 illustrated in Figures 1 and 2, it has been shown how the broad principle of aligning a conforming anode to a part can be utilized to accurately electroplate a metallic deposit of uniform, predetermined thickness on an exteriorly presented surface of a part. In this form of the invention, alignment of the anode was facilitated by aligning the same with respect to both an exteriorly aligned, and an internally aligned surface of the part, namely the member 21 and the recess 25, respectively. From the foregoing it is manifest that other surfaces could be plated in much the same manner by employing alignment of the anode with other aligned surfaces of the part.

Accordingly in Figures 3 and 4, there is illustrated a modified form of the invention, wherein the interior surface **61** of a cylinder **60** is shown positioned with respect to a cylindrically shaped anode **62**.

Accurate alignment of the anode **62** with respect to the cylinder **60** is provided for in this form of the invention by the use of fingers **63, 63**, which extend perpendicularly from spacer arms **64, 64**, the latter being shown extending perpendicularly from plates **65, 66** provided on the opposed ends of the anode **62** and secured thereto by rods **67**, and **68** respectively. For facilitating quick mounting of the anode **62** in aligned relationship with the cylinder **60**, the rod **67** is shown provided with a threaded portion **67A** together with appropriate bolts **67B, 67B**, which serve to position the plate **67** at the desired distance from the anode **62**. (See Figure 2.) By like token, arrangement of the spacer arms **64, 64** in the form of a spider permits escape of the gaseous material during the electrolytic cycle.

The modification shown in Figures 5 and 6 concerns itself with applications involving the simultaneous plating of aligned interior and exterior surfaces **81** and **82**, respectively, of a part **80**. As best shown in Figure 5, the anode apparatus **83** comprises anodes **84** and **85**, the former being shown secured to legs **86, 86** of a U-shaped member **87**, while the latter is shown mounted on the connecting leg **87A**, so as to present exteriorly of the surface **82**. Dual alignment of the anodes **85** and **84** with respect to the surfaces **81** and **82** respectively is facilitated by providing a plate **88** having the aperture **88A** thereof receivable over the member **80** and also by including a cylindrical plastic or other non-conductive disc member **89**, shown mounted on one end of the anode **85** and being received against a portion of the surface **81** as shown. For the purpose of permitting electrodeposition on a connecting end surface **82A**, the anode **85** is shown flared, as at **85A** and terminates in a plate **89A** provided for this purpose. As in the case of the anode apparatus described in Figures 1 and 2, it is manifest that the plate **89A** could be made laterally adjustable to provide a different thickness of plate on the surface **82A** as previously described. Insulating tape **87B** is provided to prevent unwanted electrodeposition, while the plate **88** is also shown as being made oversize to act as a barrier as before.

In Figures 7 and 8 there is illustrated a modified form of the invention wherein the interior surface **91** of a cylindrical part **90** is shown being electroplated by aligning the anode **92** with respect to the surface **91**. The alignment, in this form of the invention, is accomplished by provision of a plastic spider member **93**, having arms **94, 94** that are undercut as at **95** for reception with the surface **91**. (See Figure 7.) Further positive alignment of the anode **92** with respect to the surface **91** is insured in this modification by use of a pin extension **95A** which extends from one end of the anode **92** and is received within an appropriate aperture **96** of the part **90**. For the purpose of providing an equal deposit of plate on the offset surface **91A**, the anode **92** is shown undercut, as at **97**, to define a smaller diameter anode **92A**. Thus, it has been shown in this modified form of the invention how the improved anode apparatus can be aligned with respect to an interior surface which varies in surface area.

In Figures 9 through 12, there is illustrated a modified form of the invention, designed for application in plating the interior walls **101, 102, 103** of a piston ring groove **104**, presented on the exterior surface **105** of a conventional piston **106**.

The anode apparatus **110** used to accomplish the above result is shown as comprising a pair of semi-circular segments **111, 112** interconnected by a pivot pin **113** so as to be easily removable from engagement with the piston **106** by mere disengagement of the locking mechanism **114**. As best shown in Figure 10, each segment **111, 112** may comprise semi-circular plates **115, 116**, maintained in spaced relationship with each other by virtue of spacer members **117, 117**, positioned at appropriate intervals around the circumference of the plates **115, 116**. Centrally disposed between the plates **115, 116**, may be a semi-circular anode **118** of relatively thin cross-sectional diameter and having one exposed end **118A** thereof extending into the piston ring groove **104**, so as to cause the electrodeposition of metal on the walls **101, 102**, and **103** thereof in known manner. For the purpose of limiting the area of deposit to the walls **101, 102**, and **103**, the anode **118** is shown provided with insulating pads **119** and **120**, the latter also serving to separate the anode **118** from contact with the spacer members **117, 117**. (See Figure 10.) By like token, the plates **115, 116** are shown contacting the exterior surface **105**, and it is equally manifest that complete "stop-off" would be attained by increasing the thickness of the plates to the point where the same would constitute an extension of sidewalls **101**, and **103**, respectively. The requisite electric current is shown supplied to the anode **118** by providing semi-circular leads **121, 121**, extending from main leads **122, 122**, and being received with an appropriate groove **115A** provided as one face **115B** of the plate **115**. In this regard, uniformity of the current charge is compensated for by providing depending leads **121A, 121A** which directly engage the anode **118** at appropriate intervals. (See Figures 9 and 12.) In this regard it is manifest the above arrangement could be replaced by multiple leads (not shown) which would serve to replace the depending leads **121A, 121A**.

To the end of properly positioning the free end **118A** of the anode **118** within the groove **104**, finger members **125, 125** are secured to the underside **116A** of the plate **116**, and extend radially inwardly therefrom so as to be received within a parallel groove **107** in snug relationship therewith. While the provision of the finger members **125, 125** provides an accurate alignment of the anode **118** within the groove **104**, it is apparent that the plate **116** could be modified to include an integral continuous extension for reception within the groove **107** in cases where extreme accuracy was required, or similarly modified to include the use of auxiliary aligning members receivable within other grooves or aligned surfaces, including the top or bottom faces of the piston or internal members thereof which were capable of alignment with the groove to be plated.

In use of this modified form of the invention, the same would be machined both prior to and subsequent to assembly much in the same manner as described in connection with the apparatus shown in Figures 1 and 2. In this machined, preassembled condition, an operator would merely open the semi-circular segments **111, 112** about the pivot **113** and, subsequent to positioning about the piston **106**, would close the same so as to engage the fingers **125, 125** within the groove **107**. Engagement of the locking device **114** would then insure perfect alignment of the free end **118A** of the anode **118** within the groove **104** so as to cause a uniform deposit on the walls **101, 102**, and **103**, upon subsequent submersion in the electrolytic solution during the plating cycle. Upon removal from the plating solution, the apparatus **110** may be removed from engagement with the piston **106** for subsequent reuse by merely disengaging the locking mechanism **114** in known manner.

Other modifications, such as variation in the shape of the anode or, applying these teachings to use in cathodes, or aligning by use of angularly disposed surfaces capable of alignment, may be resorted to without departing from the spirit of this invention or deviating from the scope of the appended claims.

What is claimed is:

1. A device for electroplating an exterior surface of a contoured member having external and internal surfaces and being provided with at least one adjacent en-

larged surface aligned with respect to said surface to be plated, comprisng, an anode surrounding said exterior surface to be plated; a support frame extending axially from the opposed axial ends of said anode; an aligning member removably secured to one axial end of said frame member and being engageable with said aligned external adjacent surface; and a plug member, receivable against said internal surface of said member and being secured to the opposed axial end of said frame, whereby said anode is automatically aligned in parallel, equidistant relationship with said surface.

2. A device as set forth in claim 1, further including a second anode adjustably positioned between a second selected area of said member to be plated and said frame member.

3. A device for use in electroplating at least one selected external area of an article having external and internal surfaces, comprising; a surrounding anode corresponding substantially in bodily contour to the surface contour of said selected area to be plated; an aligning member, removably secured in rigid relationship to an enlarged external surface of said article; a second aligning member, removably secured in rigid relationship to said internal surface of said article; and means interconnecting said anode with said respective aligning members, whereby said anode is freely suspended in mechanically and electrically equidistant relationship with respect to said selected area to be plated.

4. A device for use in electroplating at least one selected external area of an article having external and internal surfaces, comprising; a surrounding anode corresponding substantially in bodily contour to the surface contour of said selected area to be plated; an aligning member, removably secured in rigid relationship to an enlarged external surface of said article; a second aligning member, removably secured in rigid relationship to said internal surface of said article; and means interconnecting said anode with said respective aligning members, whereby said anode is freely suspended in mechanically and electrically equidistant relationship with respect to said selected area to be plated, said means including a frame member connecting said anode with said first and second-named aligning members.

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