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APPARATUS FOR PLATING JOURNALS OF CRANKSHAFTS

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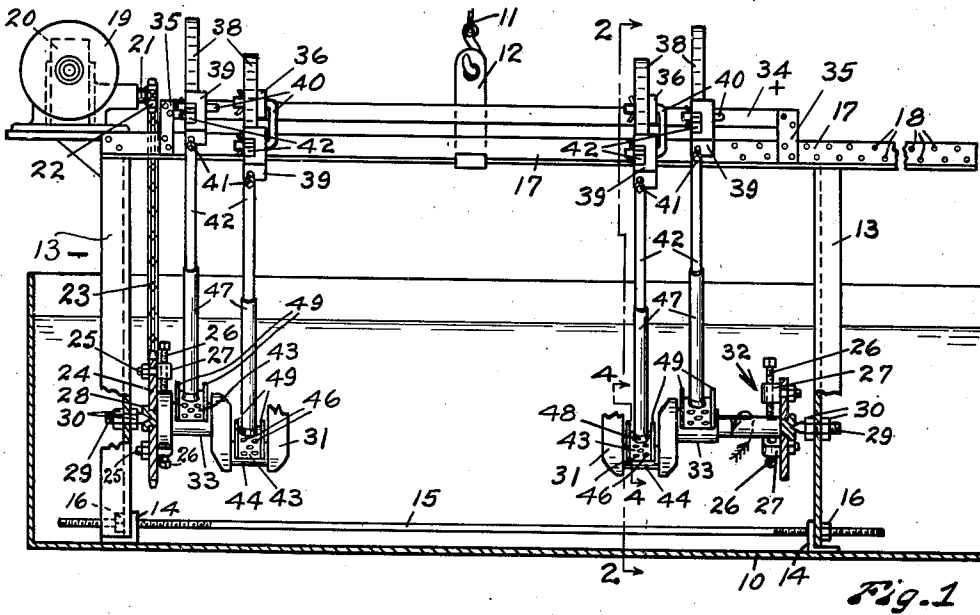


Fig. 1

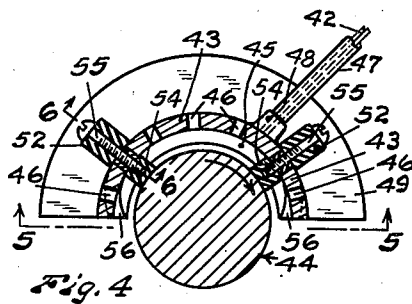


Fig. 4

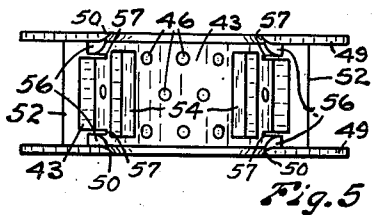


Fig. 5

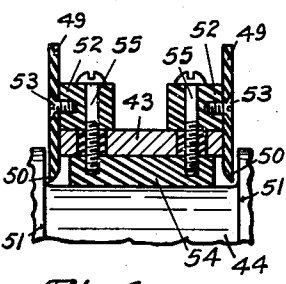


Fig. 6

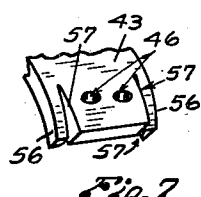


Fig. 7

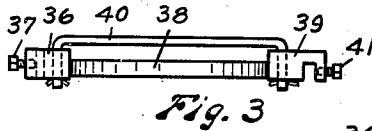


Fig. 3

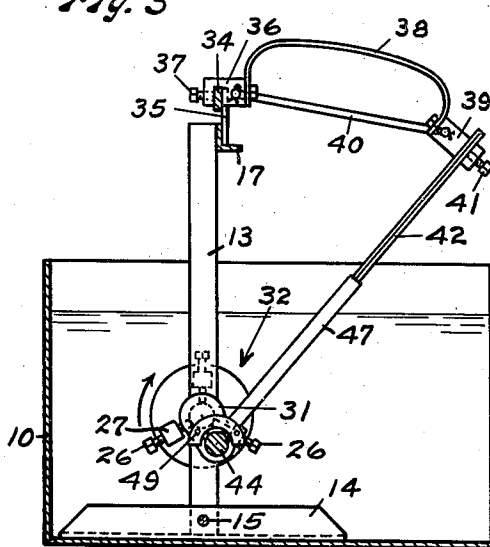


Fig. 2

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APPARATUS FOR PLATING JOURNALS OF
CRANKSHAFTS

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3 Claims. (Cl. 204—224)

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This invention relates to apparatus for plating the journals of a crankshaft.

More particularly the invention relates to the electroplating of the journals of crankshafts, such as crankshafts employed in internal combustion engines, with a suitable metal, as chromium.

While my invention is applicable to the plating of the journals of newly manufactured crankshafts, an important use of my invention is in the reclaiming of crankshafts of which the journals have become worn. Therefore, as an illustration but not as a limitation, my invention will be more particularly described in connection with the reclaiming of crankshafts, the journals of which have become worn.

Heretofore in reclaiming crankshafts having worn journals, two procedures have been followed. One procedure was to grind the journals down to the next undersize and to employ an undersized cap or bearing to fit the new size to which the journals of the crankshaft had been ground. This procedure resulted in having a motor with journals and main and connecting rod bearings therein which were not of standard size and in case of later repair work, this is a serious difficulty. The amount of crankshafts reclaimed in this manner is in part illustrated by the fact that the War Production Board has very greatly limited the manufacture of undersized bearings. Due to the fact that motor difficulties may develop requiring replacement of bearings and at great distances from the manufacturer of the motor, a motor having off size or "freak" parts as distinguished from standard parts, presents very serious difficulty. Therefore, the practice has been to attempt to recondition crankshafts so that they are substantially duplicates of the crankshafts as originally manufactured so that thereafter standard parts may be employed. Also, any grinding of crankshaft journals obviously removes some of the parent metal from the journals and thus somewhat weakens the crankshaft.

The second method heretofore employed which attempted to provide reclaimed crankshafts with standard journals was the process generally termed the "sprayed metal" process. In such process the bearings were cut with deep and ragged thread-like grooves and then molten metal sprayed to form a continuous film about the so roughened journal. Thereafter, the journal was ground and honed down to standard size.

A primary shortcoming in the "sprayed metal" process of adding metal to the crankshaft jour-

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nals is that the first step requires roughening and grinding away of parent metal from the crankshaft journals and cutting deep and ragged thread-like grooves and thus a weakened crankshaft. In the "sprayed metal" process there is substantially no fusion between the metal added and the crankshaft and there is merely a fusion of all of the metal added and relative motion between the rings or added metal and the parent metal or the original crankshaft is prevented because of the roughened condition and deep ragged thread-like grooves in the crankshaft. In any member subject to severe stress, sharp corners are always avoided because sharp corners become a focal point for the beginning of cracks.

Another difficulty encountered in the "sprayed metal" process was the fact that the metal was not sprayed evenly about a journal of the crankshaft and this fact was reflected by inaccuracy in the later grinding and polishing of the journal surface.

The later grinding difficulty resulting from uneven coating of the journals by sprayed metal was more evident in the connecting rod bearing journals as distinguished from the main bearing journals. In the manufacture of crankshafts, the lathe center marks or the centers of the crankshaft are first determined and then by the lathe operation the main bearing journals are completed about such centers. These centers, i. e., conical depressions, are left in the ends of the crankshafts. Thereafter, when a worn crankshaft is reinserted in a lathe and when the same centers are employed, the main bearing journals can be trued up so that they will have the original centers. On the other hand, in the manufacture of crankshafts special jigs and tools are employed to determine the centers of the connecting rod bearing journals. As a set of tools and jigs is necessary for each crankshaft, and as the tools and jigs which are originally employed wear and new ones must replace them, it is not practical to employ methods in reclaiming crankshafts where a special set of jigs and dies will be required for each type of crankshaft ever made. Thus in regrinding a connecting rod bearing journal, tools are employed which will find the apparent center of the connecting rod bearing journal involved depending upon the external surface. Obviously, if the connecting rod journal has been built up by adding sprayed metal thereto, any variation in the thickness of sprayed metal added will change the apparent center and thus the connecting rod bearing journal will be ground on its apparent center after

being built up as distinguished from being ground on its true or original center. Any change in the true center of the connecting rod will change the timing of the motor and either make the motor run "rough" or, in case of Diesels, will change the actual firing time. Thus, precision work in building up worn connecting rod bearing journals of crankshafts to their original size requires that the plating or the coating which is added to the journal shall be a uniform coating or plating and the "sprayed metal" process has had a shortcoming in failing to provide for a uniform addition of metal to the journal to build the same up to its original size. In addition to the non-uniformity of the addition of metal by the "sprayed metal" process there is a further complication that a journal may be out of round due to wear, and there is always a possibility of adding the error due to the journal being out of round to the error in the amount of coating so that at times the two errors are additive in their effects.

Another difficulty of the "sprayed metal" process is that the sprayed metal is not of the desired hardness and is subject to wear.

In view of such shortcomings in the prior commercial art of reclaiming crankshafts, it is an object of my invention to reclaim crankshafts without any initial grinding and initial weakening of the shaft so that none of the parent metal of the crankshaft is removed.

Next, it is an object of my invention to provide apparatus for chromium plating by an electrolysis process the crankshaft bearing journals and to provide a substantially uniform deposit of chromium thereon. This is particularly valuable in that it results in an economy in the process in not requiring excess chromium plating and next the apparent center of a journal is not changed by reason of unequal deposits of chromium. Inasmuch as the general grinding practice is to line up the journal to be ground by reason of its exterior surface, it is obvious that if the chromium plating is not uniform, the final exterior will not be uniform and the center of the journal will be changed over the original designed center thereof. Non-uniform plating of chromium is not only objectionable in changing the timing and stroke of a motor but at the same time if a deposit of chromium is non-uniform, then often after final grinding, the chromium is too thin on some sides or may be even non-existent and is heavy on others. In view of the extreme hardness and wear resistance of chrome plating it is obviously advantageous to provide a uniform wearing surface.

Another object of the invention is to provide for chromium plating of the crankshaft bearing journals not only uniformly, so far as depth of plating is concerned, but lengthwise of the journals so that the bearing surface thereof will be the original surface area.

It is a further object of the invention to provide means to continuously wipe the journals during plating, which wiping, among other effects, apparently causes the gases liberated during the electro-plating process to be properly and promptly removed so they will not affect the uniformity of the plating.

Another object of the invention is to provide apparatus which result in substantially uniform current density between the anode and cathode to thereby result in uniform plating.

Another object of the invention is to provide means so that as the crankshaft is rotated in an electrolyte during electro-plating, there will be no

wear on the original lathe or center marks of the crankshaft.

Another object of the invention is to provide apparatus whereby if the anode should be accidentally removed from the crankshaft during plating, the anodes will be thrown clear of the bearing journals and thus preventing any short circuiting with such journals which would in turn cause arcing with and burning of the bearing journals and very possibly ruining the same because of change of hardness at the burned location.

It is a further object of the invention to provide a chromium plating apparatus for the bearing journals of a crankshaft which is of such accuracy that if it be desired, a crankshaft may be ground or originally formed to a predetermined amount less than the final size desired, such as five-thousandths undersize, and then a plating of five-thousandths of an inch of chromium may be applied and the crankshaft used without any further grinding of the crankshaft.

With my invention I have been able to readily control the depth of plating within ten (10%) percent of the thickness desired. In other words, if a ten-thousandths of an inch deposit is desired, my process is being operated so that within the tolerance of one-thousandth of an inch, that is, plus or minus, the deposit may be obtained. An important result of being able to so control the thickness of the plating is that, if desired, the final grinding operation can be eliminated and it should be noted that the final grinding operation in a crankshaft having chromium plated bearing journals is particularly important in that the chromium is exceptionally hard and much more difficult to grind than is steel. Also, of course, by being able to chromium plate to size, no more chromium is applied than is actually needed.

The above mentioned general objects of my invention, together with others inherent in the same, are attained by the mechanism illustrated in the following drawings, the same being a preferred exemplary form of embodiment of my invention, throughout which drawings like reference numerals indicate like parts:

Figure 1 is a view in front elevation of my plating apparatus with a crankshaft, the center portion of which has been broken away, in operative position therein and showing a tank in section;

Fig. 2 is a view in end elevation with parts shown in section taken substantially on broken line 2—2 of Fig. 1, and in addition only one anode operating on a connecting rod bearing journal is shown for purposes of more clearly illustrating the invention;

Fig. 3 is a detached plan view of an anode connector linkage means shown in Figs. 1 and 2 of the drawings;

Fig. 4 is a sectional view, with parts in elevation, taken substantially on broken line 4—4 of Fig. 1, on a larger scale than Fig. 1, and with the anode stem connector means broken away;

Fig. 5 is a view taken substantially on broken line 5—5 of Fig. 4 and with the bearing journal omitted;

Fig. 6 is a view taken substantially on broken line 6—6 of Fig. 4; and

Fig. 7 is a fragmentary perspective of a portion of the anode and particularly an end portion thereof.

Referring to the drawings a tank 10 is provided to contain the electrolyte to be used, such as one from which hard chromium may be plated on the cathode. Also, the remainder of the

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apparatus is preferably provided in a unit which may be raised or lowered by connecting a suitable lift cable 11 with connecting means 12. Thus, the complete apparatus may be assembled as a unit, with a crankshaft 31 therein ready for the electro-plating action, and then the unit may be lowered into the electrolyte which is within the tank 10. Two end frame means 13, which may be angle irons as shown, are vertically disposed and the lower end of each is connected to a cross support or stand 14, which again may be an angle iron as shown. The spacing between vertical supports 13 is adjustable to permit crankshafts of various lengths to be processed. A means for accomplishing such purpose is to employ a tie rod 15 having right and left hand threads at its respective ends, threads in the stands 14 and in the vertical supports 13, and nut means 16. Thus, by turning movement of the tie rod in one direction the vertical supports 13 are moved toward each other and by angular movement of the tie rod 15 in the opposite direction the vertical supports 13 are moved away from each other. The vertical supports 13 are held in spaced relation from each other at their upper end portion by an angle iron 17. Preferably the angle iron 17 has a plurality of adjusting holes 18, shown to the right in Fig. 1, so that upon inserting bolts in the proper holes in securing supports 13 to angle iron 17, the effective length of the angle iron 17 between supports 13 may be adjusted in accordance with the size of the crankshaft being processed. Also, the connecting means 12 is preferably carried by the angle iron 17 and the position of the support 12 longitudinally of the angle iron 17 is such to provide substantially a balance so that only one support need be employed in moving the apparatus into or out of the tank 10. Also, the framework comprising supports 13, tie rod 15, and angle iron 17 are preferably connected to the cathode so that by means herein after described the crankshaft to have its journals plated will be the cathode in the electrolysis process.

An electric motor 19 may serve as a prime mover to rotate the crankshaft during plating. In order to provide desired speed of rotation of the crankshaft, preferably a speed reduction device 20 connects between electric motor 19 and power output shaft 21. Power output shaft 21 carries sprocket means 22 on which is mounted chain drive 23. Chain 23 is mounted on and drives sprocket 24.

A crankshaft mounting and centering chuck comprises lugs or bosses 27 carried by sprocket 24. Stud bolts 25 may be employed to connect bosses 27 with sprocket 24. A plurality, as three, centering means are employed which may be in the nature of set screws 26 which are threadedly mounted in the bosses 27 and protrude to engage the circular periphery of the crankshaft or a flange carried thereby.

In order to eliminate any wear on the lathe centers or conical depressions at the ends of the crankshaft being processed, a removable center or bearing 28 is provided. Such member 28 is rigidly secured to sprocket 24, as by being press fitted into a recess therein, and has a tapered centering bearing for receiving set screw 29 which has a matching protruding cone. Set screw 29 is provided with two nuts 30 and is carried by uprights 13 so that an adjusted amount of projection of the set screw 29 may be maintained.

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In order to process a crankshaft, first, a crankshaft mounting and centering chuck comprising sprocket 24, bolts 25, screws 26 and bosses 27, is mounted on one end of the crankshaft and a similar chuck 32 is mounted on the other end. The only difference between the structure designated generally by 32 and the crankshaft mounting and centering chuck 24-25-26-27 is that the latter carries the sprocket 24 while the former has merely a plate or in other words only the latter provides for the power to rotate the crankshaft 31 which need be accomplished only at one end of the crankshaft. Then the set screws 26 in bosses 27 in the chucks at the respective ends of the crankshaft are adjusted so that the centering devices are the center of the crankshaft or, in other words, the center about which the main bearing journals 33 of the crankshaft were formed. After the crankshaft 31 has the centering devices mounted at its respective ends, the tie rod 15 and frame means 17 are adjusted to suitable length to fit a particular crankshaft, the nut means 30 are loosened and the set screws 29 adjusted so that the crankshaft 31 will rotate freely about set screws 29 as the line of center of the crankshaft.

In order to control the current density and in turn the extent of chromium plating on the journals of the crankshaft, I employ the crankshaft as the cathode in the electrolysis process. The electrical energy connected to the frame means 13 will be transferred via the centering means at each end of the crankshaft to the crankshaft and also energy will be transmitted by way of the chain drive 23 as the cathode is the grounded part of the system and all of the grounded parts are interconnected.

Referring to the anode circuit, a bar 34 is provided which is insulated from the frame or grounded part of the mechanism. This may be accomplished by mounting bar 34 on two insulation strips 35. I desire to provide an anode in close proximity to each bearing journal which is to be plated to control current density and extent of plating. Thus, I provide a connector block 36 having an opening into which is inserted a portion of the anode bar 34 and a set screw 37 to thus provide detachable and positive connection between each connector block 36 and the anode bar 34. A flexible and preferably copper ribbon-like strip 38 electrically connects block 36 and block 39. An interconnecting link 40 is pivoted at its respective ends to the blocks 36 and 39. The block 39 is provided with an opening and a set screw 41 so as to detachably and rigidly connect the block 39 with a rod or anode connector stem 42.

Referring to Figs. 4 to 7 of the drawings, each rod or stem 42 is connected with an arcuate shaped anode 43 which is positioned in relatively close spaced relation to a journal on a crankshaft as a connecting rod bearing journal 44. By providing an anode 43 of conforming and matching shape in close proximity as by a space indicated by 45 in Fig. 4, to a connecting rod bearing journal 44, substantially all of the electro-plating action will occur on the connecting rod bearing journal 44.

A plurality of openings or perforations 46 are provided in the normal upper surface of each anode 43 thus permitting the upward escape of liberated gases therethrough which are generated during the electro-plating action. The size and number of such openings 46 does not appear to critically affect the current density of electro-

plating so the area of such openings may be rather liberal to insure rapid escape of the gases.

In order to provide electrical connecting means between the anode bar 34 and the anode 43 which will vary sufficiently in length so that the anode 43 can follow a revolving connecting rod journal 44, I employ the link 40, pivotally mounted at both ends, and dispose the anode stem 42 at an angle of substantially forty-five degrees to the vertical. Thus, as the anode 43 follows the connecting rod journals 44 as they revolve, the openings 46 will always be above the surface area of the journals 44 which are being plated and thus the gases generated during electroplating can readily rise upwardly and out through such openings.

As lead anodes are less affected by the action occurring during electro-chromium plating, preferably the anode 43 is formed of lead. As to the stem 42, the same may be shielded by means of shield 47, which is a tube formed of any suitable non-conductor which will not be adversely affected by the electroplating bath, and thus the anode stem may be made of any suitable material such as steel. In the event that the anode stem 42 is formed of steel and is protected by a shield such as 47, the anode stem 42 should be lead welded, as by weld 48, to the anode 43 so that any exposed steel portions of anode stem 42 will be well up within the tube 47. Even though electrolyte will leak up in the tube 47 and adjacent the anode stem 42 there will be substantially no etching or dissolving occurring due to the effect of the shield 47.

Referring in more detail to the construction and supporting means of the anode of Figs. 4 to 7, inc., I employ two side shields 49. These may be formed of any suitable non-conducting plastic which will not be adversely affected by the electrolyte. These shields 49 are in the form of substantially one-half of an annular ring and each preferably has its lower edge portion tapered away to form substantially sharp edge portions 50. These sharp edge portions 50 are designed to ride in close proximity to the corners or outside edges of a bearing journal so that the plating will be limited to the bearing journal by shielding and substantially no electro-plating will occur on the shoulders adjacent the bearing journals such as shoulders 51 of Fig. 6.

The side shields 49 are spaced from each other and connected to the anode 43 by any suitable means which may include: four blocks 52 secured to side shields 49 by means of screws 53; two scraper and anode positioning blocks 54; and screws 53, which are insulated from anode 43. The scraper blocks 54 and blocks 52 are formed of materials similar to the materials forming the side shields 49. The principal function of blocks 54 is to positively determine the spaced relation between the anode and the cathode.

While the shields 49 tend to limit the flow of current in definite paths between the cathode and the anode and thereby control the current density so that there will be the desired plating at the ends of the connecting rod bearing journals 44 which are adjacent the shoulders 51, yet I prefer to shape the end portion of each anode 43 as is best shown in Fig. 7 of the drawings. This requires a less critical relation between the shields and the cathode 44. Each end of the anode 43 has two cuts in a line circumferentially of the anode 43 and the portions 56 are bent laterally leaving V-shaped slots 57 and the portions 56 are further bent radially inwardly

toward the connecting rod bearing journals 44. Thus, the portions 56 are in closer proximity to the corners formed between connecting rod journals 44 and the shoulders 51 and thus there is an increase of current density at such locations and insurance is provided so that there will be proper plating of the journals 44 and particularly in the corners adjacent the shoulders 51.

In operating the structure of this invention, first a crankshaft 31 is mounted for rotation on the centering chucks riding on 28 and 29 at its respective ends. Exact precision mounting of the crankshaft on such centers is not essential as the anode means will follow the journal to be plated even though the crankshaft is not precisely centered. Also, due to the fact that a chain drive is employed so that there can be sufficient slackness, failure to precisely center the crankshaft 31 will not bring adverse results. Then an anode 43 with the parts connected therewith is connected to the anode bar 34 so that one anode is provided for each journal which is to be plated, whether the journal is a connecting rod bearing journal or a main bearing journal. As the blocks 36 are detachably connected with the anode bar 34 suitable spacing can be readily obtained so that the anodes 43 are aligned with the journal which is to be plated by the particular anode 43 involved. Next, current is permitted to flow between the cathode and the anode and at the same time the crankshaft 31 is rotated so there will be relative rotary motion between each anode and the journal which such anode is plating. My experience indicates that the speed of rotation of the crankshaft is not critical and may be over a substantially wide range with satisfactory results. However, I desire that the crankshaft shall rotate at relatively lower speeds as such lower speeds give less wear on the equipment as the wear increases with the speed of rotation of the crankshaft. Also, preferably the anode stem 42 is angularly disposed toward the crankshaft 31 and the crankshaft 31 is rotated in the direction of the arrows of Figs. 2 and 4 so that if an anode stem and the anode connected therewith should not follow a connecting rod bearing journal which is being plated, then the anode stem 42 and the anode connected therewith will swing to the right of the showing in Fig. 2 of the drawings and thus eliminate a possibility of a short circuit between an anode and the connecting rod journal which will be the cathode which was being plated. Also, the insulated portions 49 and 47 will prevent short circuiting to tank 10. In the event of arcing between an anode and a connecting rod journal, there will be burning at the point of the short circuit and if a journal is burned by an electric current, the journal tends to harden locally at the point of burning. Any bearing which has some part harder than the others, such as due to burning, will have very limited utility in that the wear and friction involved in a bearing and a journal of such character will be non-uniform and the journal may not be successfully ground. Also, by providing an anode connection means which comprises the link means 40 and the anode stem 42 which are angularly disposed as respects each other, I provide for sufficient extensibility and shortening of the length of the anode connection so that the anode may follow a revolving member such as a connecting rod bearing journal. One of the most important features in control of chromium plating is control of current density. By current density is meant the density of amperes per square inch of cathode to be plated.

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Current density control is perhaps more important in chromium plating than in most other types of plating because the deposition of chromium in quantity is not directly proportional to the changes in current density, that is, if the current density is doubled we will not have two times the amount of chromium deposited per unit of time and the amount of chromium deposited by doubling the current density will be closer to three times. Any change in the distance of the spacing between the anode and the cathode will change the current density and similarly the current density in the center of the space between the anode and the cathode will be different from the current density at the edges between the same cathode and the anode unless provision is made to increase the current density at the edges. A theory which will probably explain why the current density in the center of the space between an anode and cathode is different than the current density at the outer edges is that in the center the current travels in a path directly between the cathode and the anode and does not tend to "fan out" whereas on the edges, the current tends to fan around the corners and follows other paths so there is not the concentrated current density between the cathode and the anode because of such phenomenon. Therefore, I have provided side shields 49 which tend to limit the path of the current and therefore the amount of current which tends to fan out and pass between the anode 43 and some other part of the crankshaft functioning as a cathode. In addition I have provided the edge portions 56 of the anode 43 which are closer to the corners between the journal 44 and the shoulders 51 than the anode 43 is to the center portions of the journal 44.

While it is not critical that the anode 43 be spaced a predetermined definite amount from a journal 44, in practice I have found that the spacing 45 of Fig. 4 may be approximately one-quarter of an inch and that the spacing of the portions 56 from the journal 44 may be approximately three thirty-seconds of an inch.

While the principal function of bars 54 is to positively control the spacing between anode 43 and the cathode being plated, other phenomena seem present. The gases rising, which are liberated during electrolysis shunt off part or decrease current flow therethrough and thus locally decrease the current density, and therefore result in a lighter plating at locations on the cathode separated from the anode by such gases. As gas is liberated the bubbles rise and pass out through opening 46 and if they tend to adhere to the cathode 44 they appear to be scraped off by scraper bars 54. Thus, I overcome any tendency of the liberated gas from interfering with the current density and providing non-uniform plating. In addition to the liberated gases interfering with the current density, I have found that the chromium as deposited appears to interfere with current density. In other words, particles or threads of chromium as deposited decrease, at such location, the space between the anode and the cathode and which increases the current density and tends to further build up local areas. Bars 54 appear to scrape off and smooth down almost immediately the various threads of chromium as they are formed and any high points so that I am able to maintain uniform current density and uniform plating without interference by reason of the chromium which is being deposited. While said plating may be obtained without a

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scraping action, such scraping action is preferable. By controlling the current density so the same will be uniform between the anode and the cathode which is to be plated, the amount of plating becomes a function of time so that by employing a standard ampere flow between the cathode and the anode, cathode structures of uniform sizes and proportions, and maintaining other conditions uniform, I am able to determine by a time interval alone the exact quantity of chromium which is being plated and within ten percent (10%) tolerances in commercial operation.

Another feature which enters into uniform current density and uniform plating involves the use of substantially the same character of electrolyte between each anode and the cathode to be plated. This may be accomplished by adequate circulation of the solution so that the density of the electrolyte between each anode and its mating cathode is substantially the same. I have discovered that the revolving connecting rod bearing journals function as a circulating means and provide sufficient circulation of the electrolyte without the addition of further means.

Thus, in my process I provide for the electroplating of cylindrical shaped bodies, such as the main and connecting rod bearing journals of a crankshaft. In such process the surface to be plated functions as the cathode in an electroplating process. Next, I provide an arcuate shaped anode in the electroplating bath which is disposed in relatively close spaced relation to the cathode. As a means of providing substantially uniform current density between operative surfaces of the cathode and the anode, first, I may employ an anode where the central portion is substantially in uniform spaced relation from the cathode and the side portions of the anode are in closer spaced relation to the cathode than the central portion of the anode is to such cathode. Second, I may employ shielding means so that the path of flow of current is limited to substantially between the cathode to be plated and the anode. Or, I provide a combination of the two. Preferably, the anode is provided with a plurality of openings so that gas liberated during electrolysis may rise through such openings. Also, I provide a spacer member so that there is substantially uniform space relation between the cathode and the anode. Such spacer member is preferably a combined spacer and scraper member so that as the cathode is being rotated or revolved, the spacer member will continuously during plating rub and scrape the surface of the cathode. This results in the removal of gas bubbles which tend to adhere to the cathode and further dressingly polishes the cathode during plating and thus eliminates any high spots or spots closer to the anode which would disturb the current density at such location. The electrical connection means between the source of anode current and the anode is preferably in the form of pivotally interconnected link means so that sufficient change in the effective length of such electrical conductor may be had to compensate for the plating of a rotating or revolving surface. By reason of this connection and by reason of the weight of the anode means, which includes lead member 43, the anode means is adapted, by the pivotally interconnected link 40, to be urged toward the portion of the crankshaft being plated, and the scraper members 54 ride on and scrape the bearing 44 being plated. Also the link which connects directly to the anode is at an angle

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so the anode will fall clear of the cathode, if accidentally released, thus preventing short circuiting to the cathode. Also, preferably I provide detachable chucks providing bearing support on which the crankshaft may be rotated and thus any wear on the bearings due to the electrolysis will be had on replaceable bearings and not on the crankshaft proper.

Obviously, changes may be made in the forms, dimensions, and arrangement of the parts of my invention, without departing from the principle thereof, the above setting forth only a preferred form of embodiment.

I claim:

1. Apparatus for electro-plating the main and connecting rod bearing journals of a crankshaft which comprises a tank containing an electroplating bath in which the crankshaft is submerged; means connecting the crankshaft with a cathode; means for rotating the crankshaft in the electro-plating bath; and an anode means slidably mounted on and urged toward the journal surface of the crankshaft being plated, said anode means comprising an arcuate shaped anode, having its center portion in one circular path and its side portions bent radially inwardly therefrom at their ends, pivotally interconnected and angularly disposed link means connected at one end to a fixed support and at the other end to the anode and connecting the anode with a source of anode current, non-conductor means slidably contacting and rubbing the journal surface being plated and supporting the anode in spaced relation thereon, and shielding means at the ends of the anode, extending inwardly toward the journal being plated, and limiting the path of current flow there past.

2. Apparatus for electro-plating the main and connecting rod bearing journals of a crankshaft which comprises a tank containing an electroplating bath in which the crankshaft is submerged; means connecting the crankshaft with a cathode; means for rotating the crankshaft in the electroplating bath; and an anode means slidably mounted on and urged toward the journal surface of the crankshaft being plated, said anode means comprising an arcuate shaped anode having a plurality of gas escape openings therein, pivotally interconnected and angularly disposed link means connected at one end to a fixed support and at the other end to the anode and connecting the anode with a source of anode current, non-conductor means slidably contacting and rubbing

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the journal surface being plated and supporting the anode in spaced relation thereon, and shielding means at the ends of the anode, extending inwardly toward the journal being plated, and limiting the path of current flow there past.

3. Apparatus for electro-plating the main and connecting rod bearing journals of a crankshaft which comprises a tank containing an electroplating bath in which the crankshaft is submerged; chuck means disposable on the respective ends of the crankshaft, each said chuck means having bearing means alignable with the center of rotation of the crankshaft; means connecting the crankshaft with a cathode; means for rotating the crank shaft in the electro-plating bath; and an anode means slidably mounted on and urged toward the journal surface of the crankshaft being plated, said anode means comprising an arcuate shaped anode, pivotally interconnected and angularly disposed link means connected at one end to a fixed support and at the other end to the anode and connecting the anode with a source of anode current, non-conductor means slidably contacting the journal surface being plated and supporting the anode in spaced relation thereon, and shielding means at the ends of the anode, extending inwardly toward the journal being plated, and limiting the path of current flow there past.

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